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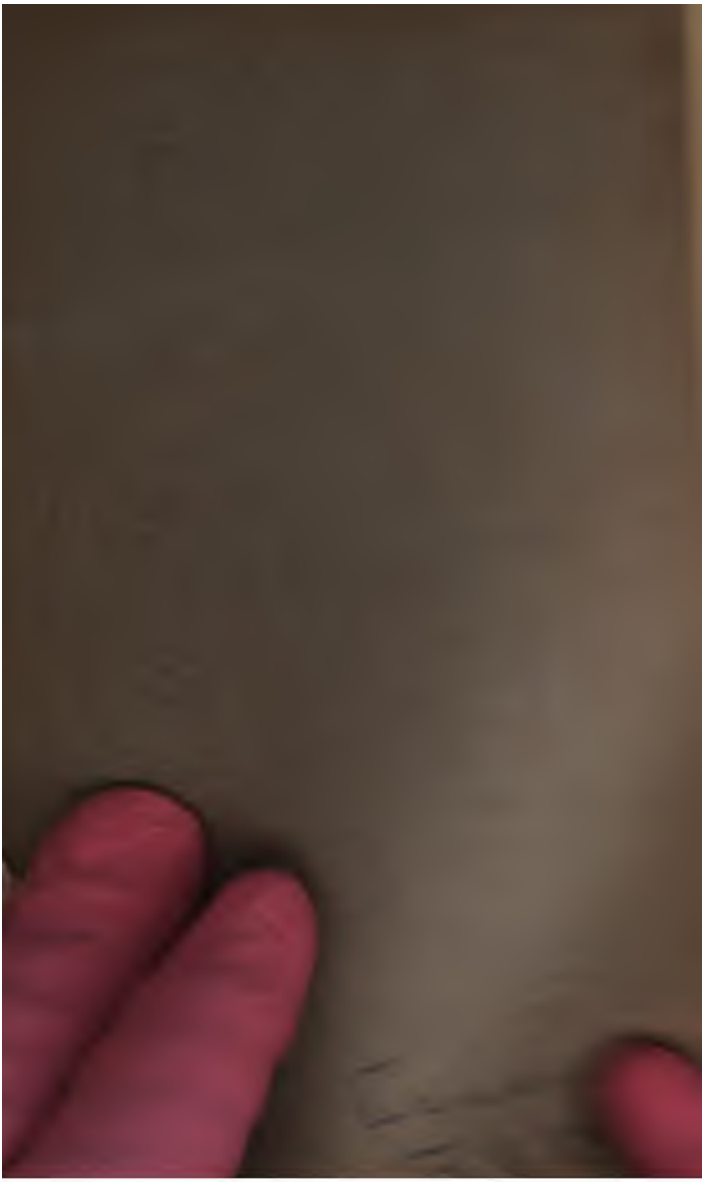

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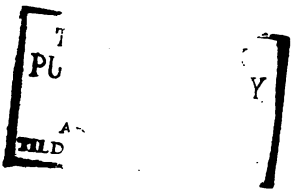

# CAMBRIA STEEL

A handbook of information relating to

## STRUCTURAL STEEL

Manufactured by the

# CAMBRIA STEEL CO.

ontaining useful tables, rules, data and formula
for the use of

ENGINEERS, ARCHITECTS,

BUILDERS AND MECHANICS.

GENERAL OFFICE, PHILADELPHIA.

WORKS, JOHNSTOWN, PA.

1901

Engineers R.R.
Gift
C. M. Keys
FEB 27 1918

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## PREFACE TO FOURTH EDITION.

The fourth edition of our handbook is much larger than the preceding ones, and in place of the tables of weights and dimensions of the earlier editions, it includes plates of sections, complete tables of weights, dimensions and properties of the principal structural shapes manufactured by us, together with various other data, formulæ and tables of value to engineers and others.

The tables pertaining to structural shapes were specially prepared for this edition, and those giving the properties of I-Beams, Channels and Angles, safe loads of I-Beams and Channels, and spacing of I-Beams are given in detail for each section, so that required information can be obtained without interpolation, a feature which it is believed will add to their value and convenience.

The general mathematical tables, engineering formulæ, and information relating to materials not manufactured by us, have been carefully compiled from original or authentic sources, and have been amplified or condensed, corrected or rearranged in a manner thought best to insure accuracy and convenience in use.

## PREFACE TO FIFTH EDITION.

This, the fifth edition, contains all of the data of the fourth edition, which, however, has been corrected where necessary and revised to conform to our present practice.

The present edition also contains a large amount of new matter, including drawings of new sections of T-Bars, special Channels and special Angles with tables of weights, dimensions and properties thereof.

Other new matter has also been introduced, the principal items of which are as follows: Drawings and tables relating to new standard connection angles for beams and channels, giving location and other data for sections of different depths framing opposite each other; tables of safe loads for beam columns, latticed channel columns, plate and channel columns, plate girders and beam box-girders; also tables of dimensions of Z-Bar columns, latticed channel columns and plate and channel columns.

Tables giving radii of gyration of two angles placed back to back, properties and principal dimensions of Standard T-Rails, information relating to grillage beams and plates of drawings showing certain typical details of construction have also been added.

COLUMBIA UNIVERSITY

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## GENERAL INFORMATION.

Our product is almost exclusively steel, made by the Bessemer or Open Hearth process as required, and of all qualities from the softest rivet stock to high carbon special spring material.

Our Beams and Channels are made to conform to the American Standards, adopted January, 1896, in which the flanges have a uniform slope of one to six, and the dimensions, proportions and weights are determined by a regular schedule, as shown on the diagrams on pages 22 and 23. The standard proportions of beams and channels are further shown on Plate 24.

The principal structural angles now made are limited in number to conform to the American Standards, adopted December, 1895, and include eleven base, or a total of seventy-three, sizes for equal leg angles, and nine base, or a total of eighty-six, sizes of unequal leg angles, all varying in thickness by one-sixteenth inch, as shown on Plates 12 and 14 and tables herein. It is believed that these standard angles include a sufficient range of sizes to meet all usual structural requirements, but at the same time we will continue the manufacture of angles of special sizes and proportions for those who require them, as shown on Plates 13 and 15.

The method of increasing the sectional area of shapes from minimum or base sizes to intermediate and maximum sizes, is shown on page 21. For beams and channels the increase from the minimum adds equally to the web thickness and flange width, the weight of the increase being equal to that of a plate of the same depth as the section, and of a thickness *equal to* the increase of the dimensions stated.

*The method of increasing* the thickness of angles and Z-Bars from

the minimum has the effect of adding to the length of the legs, as shown on page 21, so that for intermediate and maximum sizes the legs will be somewhat longer than the minimum or nominal dimensions, except in the cases for which we have finishing grooves. The plates of drawings of sections, pages 2 to 20 inclusive, show the minimum or base sizes of the various shapes. Sections shown on the plates or lists for which more than one weight is stated can be rolled of different thicknesses to produce the stated weights. Others for which only one weight is given cannot be varied. Each section shown herein is numbered, both in the plates and tables, for convenience in reference and ordering.

I-Beams and Channels should be ordered of weights shown in the tables. Intermediate weights will be charged for at the next higher weight on the list.

Deliveries of shapes of standard weights and sizes which are kept in stock can be made more promptly than of special sizes made to order. Orders should specify either the thickness or weight, but not both.

All weights are stated in pounds per lineal foot of section, except for rails which are given in pounds per yard as customary. Weights of rolled sections are calculated on the basis of 489.6 pounds per cubic foot of steel, and 3.4 times the sectional area in square inches equals the weight in pounds per lineal foot. In calculating the weights, areas, and properties of I-Beams, Channels, and structural angles for the lists and tables herewith, the fillets and smaller rounded corners were not considered.

Structural material, unless otherwise ordered, will be cut to length with variation not to exceed $\frac{1}{8}$ inch more or less than that specified. For cutting to exact lengths or with less variation than $\frac{1}{8}$ inch an extra price will be charged.

*All sections shown herein* are steel.

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## CAMBRIA STEEL CO.'S

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GENERAL OFFICES, PHILADELPHIA: [redacted] Arcade Building, [redacted] Fifteenth and Market Streets (opposite P. R. R. Offices and Terminal Station).

NEW YORK .....Empire Building, 71 Broadway.

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## STEEL RAILS.

Steel T-Rails, 8 lbs. to 100 lbs. per yard.
Angle and Plain Splice Bars.
Standard and Special Track Bolts and Nuts.
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---

## STEEL STREET RAILS.

Girder, Groove, Guard, and Special Rail Sections.
Brace and Plain Tie Plates, Tie Rods, etc.
For Detailed Information, see Street Rail Catalogue.

---

## STEEL AXLES.

Passenger Car, Freight Car, Tender Truck,
Engine Truck, Driving, Street Car,
Mine Car, etc.

---

## CRANK PINS, PISTON RODS.

Crank Pins and Piston Rods made to any requirement.

---

## FORGINGS.

Side Rods, Guides and General Forgings.

---

es, Crank Pins, Piston Rods and Forgings will be furnished of
steel or nickel steel as required and will be annealed, oil tem-
or treated by our Coffin toughening process (patented) as
ed.
icular attention is called to our Coffin process of treatment for
ning Axles, Crank Pins, Piston Rods and other forgings.
special list for description and specifications of our various
*of steel forgings.*

## GAUTIER DEPARTMENT

## OF

## CAMBRIA STEEL CO.

MERCHANT BAR STEEL,

Including Tire, Toe Calk, Machinery, Carriage Spring, Baby Carriage Spring, Railroad Spring, Hoe, Rake, Fork, Forging, etc.

AGRICULTURAL STEEL AND SHAPES,

Finger Bars, Knife Backs, Rake Teeth, Bundle Carrier Teeth, Tedder Forks and Springs, Spring Harrow Teeth, Harrow (Drag) Teeth, Seat Springs, etc.

PLOW STEEL,

Flat and finished Plow Shapes, Digger Blades, Bars and Slabs (Penn and Pernot), Hammered Lay, Rolled Lay, etc.

COLD ROLLED STEEL,

Rounds, Squares, Flats, Shafting, and Special Shapes.

STEEL DISCS WITH ROLLED BEVEL,

10″ to 20″ diameter for Harrows, Drills, Cultivators, etc.

23″ to 28¼″ diameter for Plows.

PRESSED STEEL SEATS FOR AGRICULTURAL IMPLEMENTS.

For Gautier Steel Department Products not listed herein, see special Catalogue, or address,

**GAUTIER DEPARTMENT,**

***Cambria* Steel Company, Johnstown, Pa.**

# PLATES

OF

# STRUCTURAL STEEL SHAPES

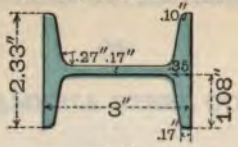
MANUFACTURED BY

CAMBRIA STEEL CO.

# STANDARD BEAMS

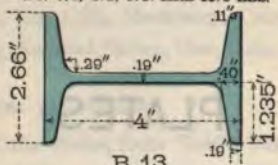
## B. 5

WT. 5.5, 6.5 AND 7.5 LBS.



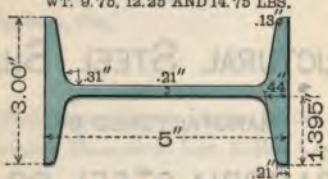

## B. 9

WT. 7.5, 8.5, 9.5, AND 10.5 LBS.



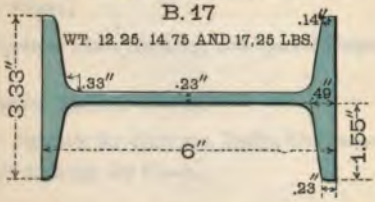

## B. 13

WT. 9.75, 12.25 AND 14.75 LBS.



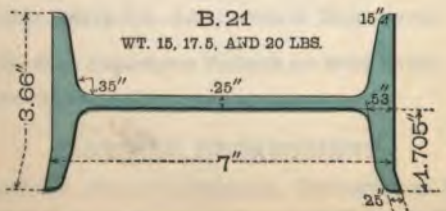

## B. 17

WT. 12.25, 14.75 AND 17.25 LBS.




## B. 21

WT. 15, 17.5, AND 20 LBS.



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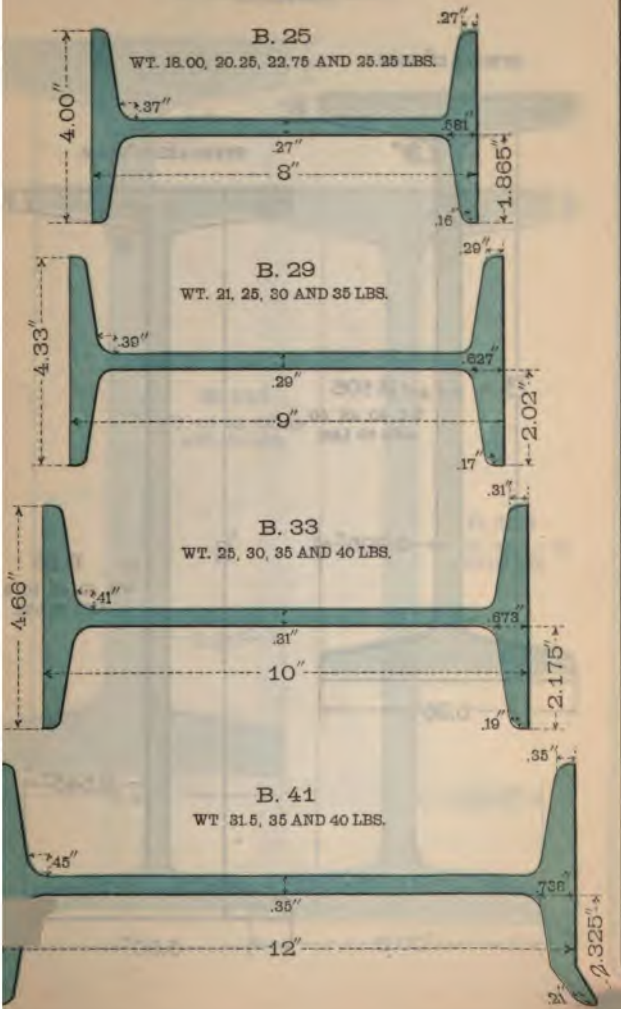
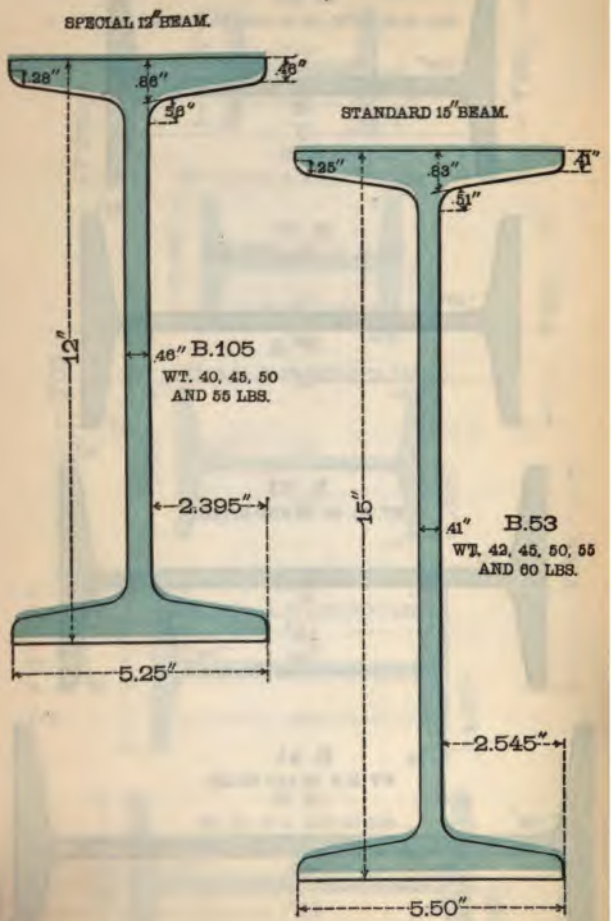
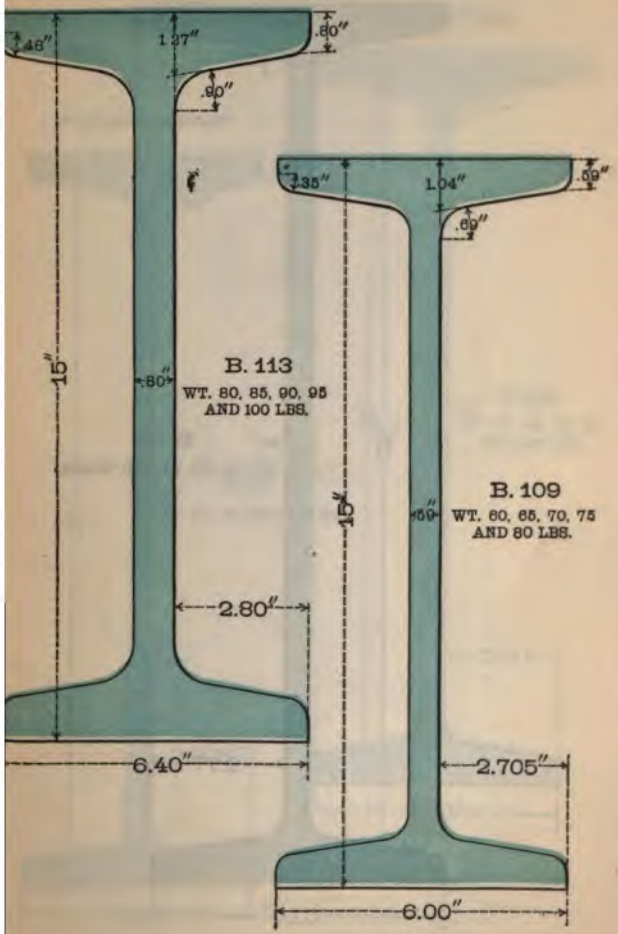


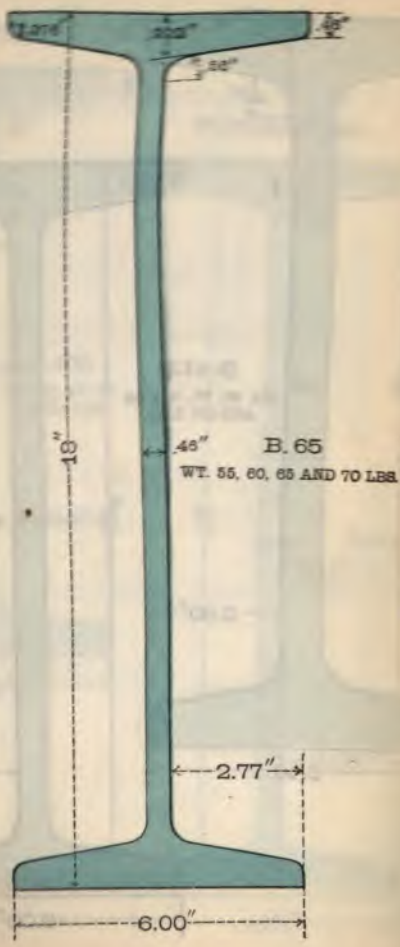
# BEAMS.


SPECIAL 12" BEAM.
1.28"
.66"
.46"
.58"
12"
.46" B.105
WT. 40, 45, 50
AND 55 LBS.
2.395"
5.25"
STANDARD 15" BEAM.
1.25"
.63"
.41"
.51"
15"
.41" B.53
WT. 42, 45, 50, 55
AND 60 LBS.
2.545"
5.50"

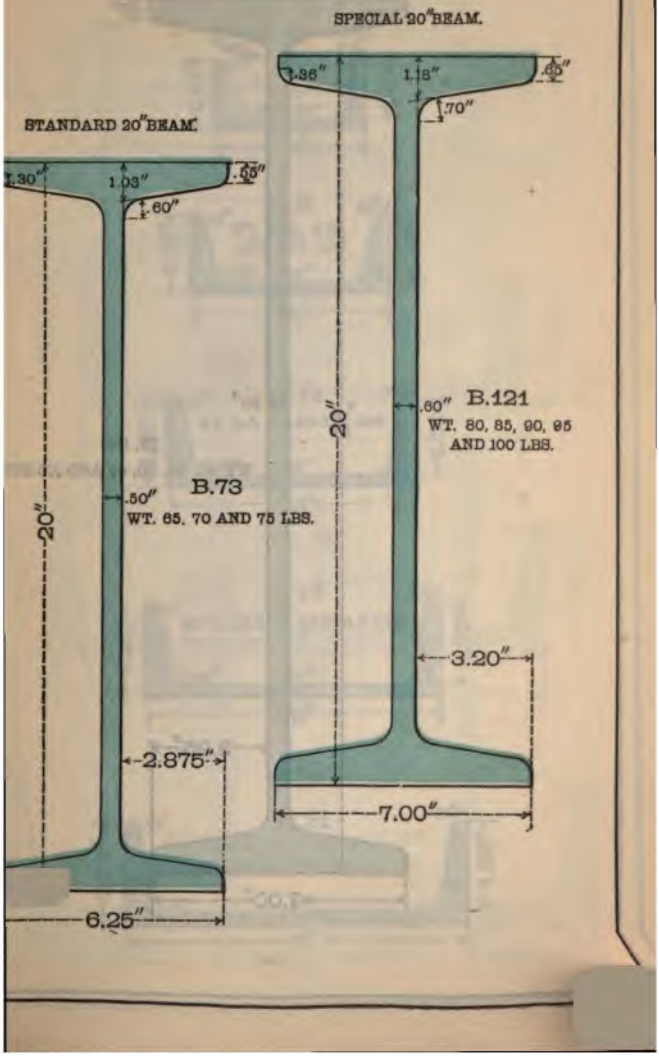
## SPECIAL BEAMS.



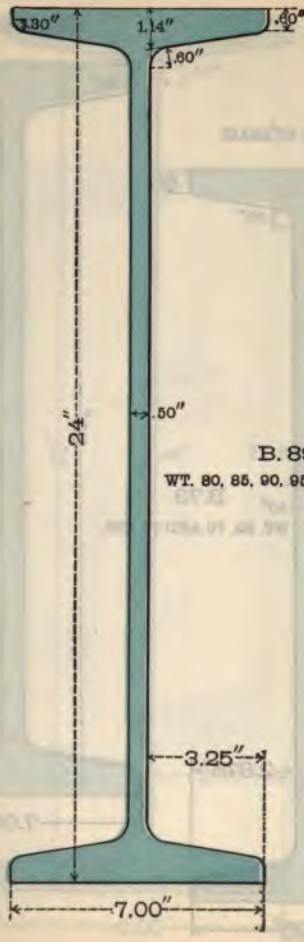
# STANDARD BEAMS.



# BEAMS.


SPECIAL 20" BEAM.
1.36"
1.18"
.65"
.70"
STANDARD 20" BEAM.
1.30"
1.03"
.65"
.60"
20"
.60"
B.121
WT. 80, 85, 90, 95
AND 100 LBS.
20"
.50"
B.73
WT. 65, 70 AND 75 LBS.
3.20"
2.875"
7.00"
6.25"

## STANDARD BEAMS.



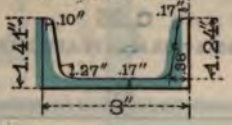

B. 89

WT. 80, 85, 90, 95 AND

# STANDARD CHANNELS.

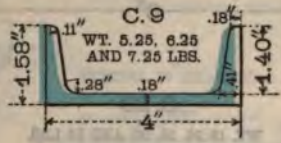
## C. 5

WT. 4, 5, AND 6 LBS.



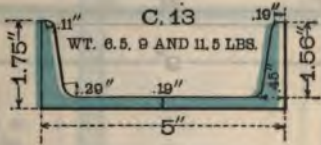

## C. 9

WT. 5.25, 6.25 AND 7.25 LBS.



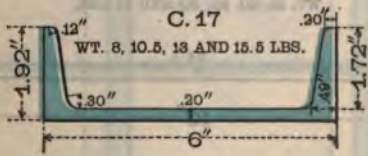

## C. 13

WT. 6.5, 9 AND 11.5 LBS.



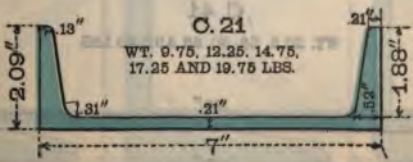

## C. 17

WT. 8, 10.5, 13 AND 15.5 LBS.

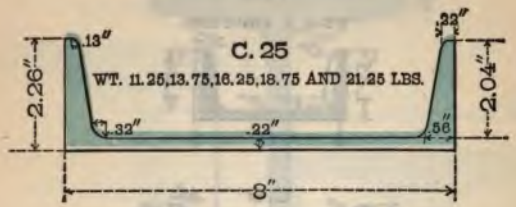


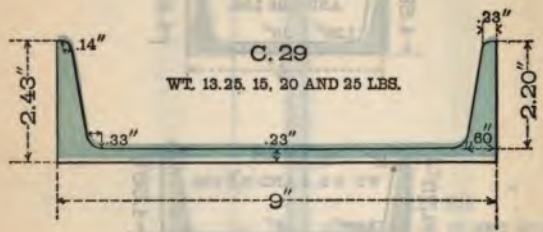

## C. 21

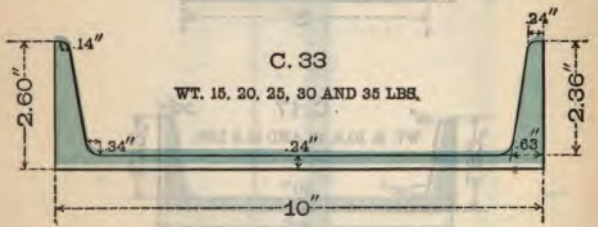
WT. 9.75, 12.25, 14.75, 17.25 AND 19.75 LBS.

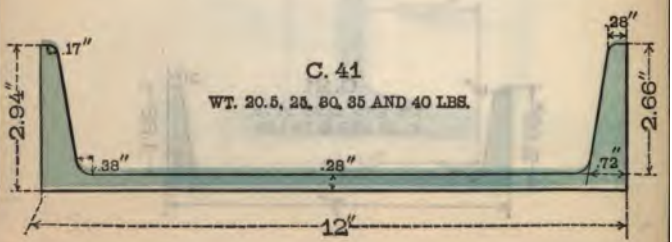


# STANDARD CHANNELS.

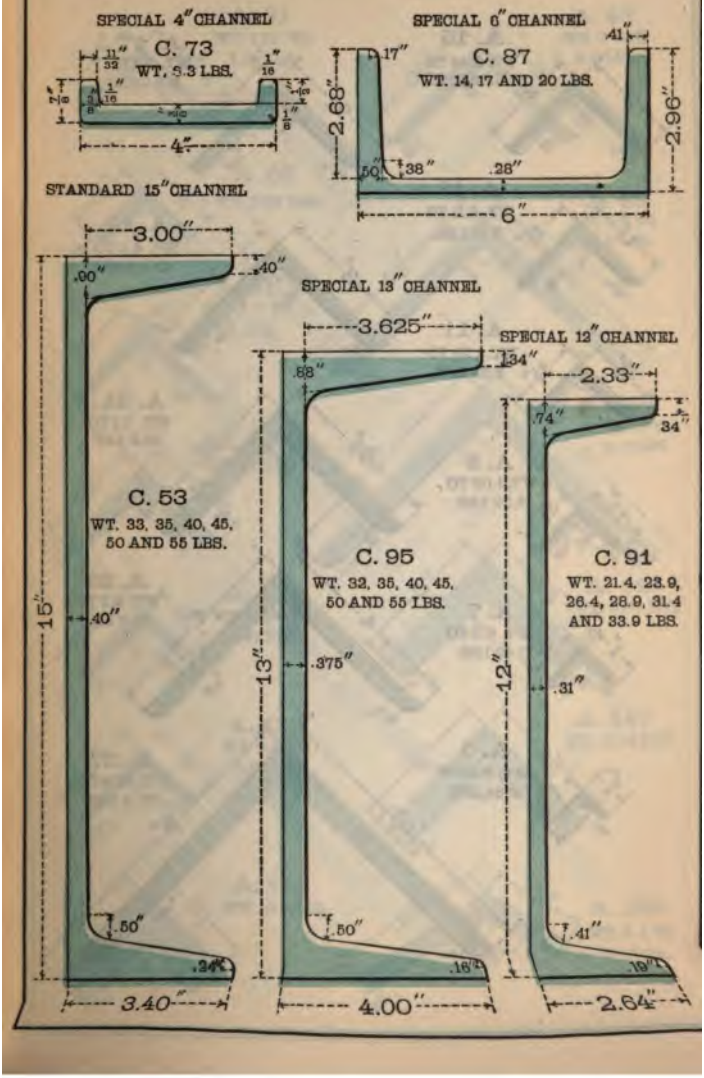


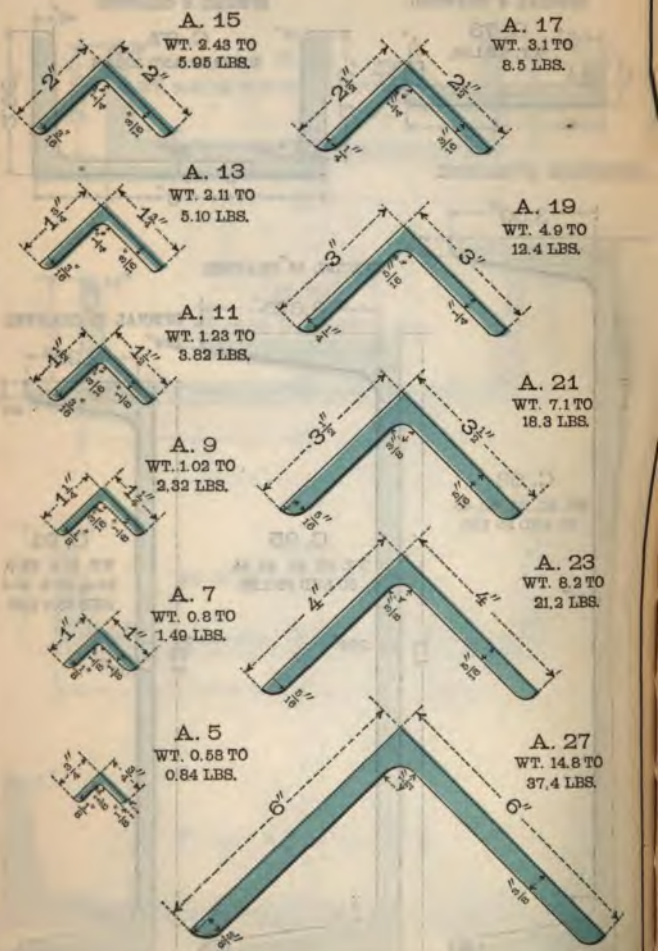



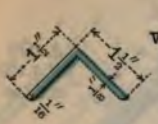
# CHANNELS


SPECIAL 4" CHANNEL
C. 73
WT. 5.3 LBS.
4"
SPECIAL 6" CHANNEL
C. 87
WT. 14, 17 AND 20 LBS.
2.68"
2.96"
6"
STANDARD 15" CHANNEL
C. 53
WT. 33, 35, 40, 45, 50 AND 55 LBS.
3.00"
15"
3.40"
SPECIAL 13" CHANNEL
C. 95
WT. 32, 35, 40, 45, 50 AND 55 LBS.
3.625"
13"
4.00"
SPECIAL 12" CHANNEL
C. 91
WT. 21.4, 23.9, 26.4, 28.9, 31.4 AND 33.9 LBS.
2.33"
12"
2.84"

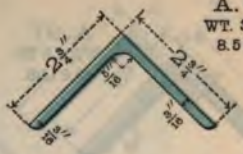
## STANDARD ANGLES WITH EQUAL LEGS.



# SPECIAL ANGLES.




**A. 61**
WT. 1.23 TO 1.79 LBS.




**A. 43**
WT. 3.4 TO 8.5 LBS.

**A. 65**
WT. 2.07 LBS.

**A. 45**
WT. 9.2 TO 19.5 LBS.

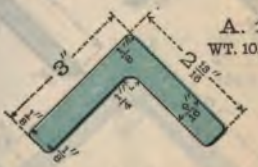
**A. 41**
WT. 2.7 TO 6.1 LBS.

**A. 47**
WT. 12.3 TO 21.8 LBS.

**A. 67**
WT. 4.5 LBS.

**A. 145**
WT. 9.80 LBS.

**A. 121**
WT. 2.03 TO 4.37 LBS.



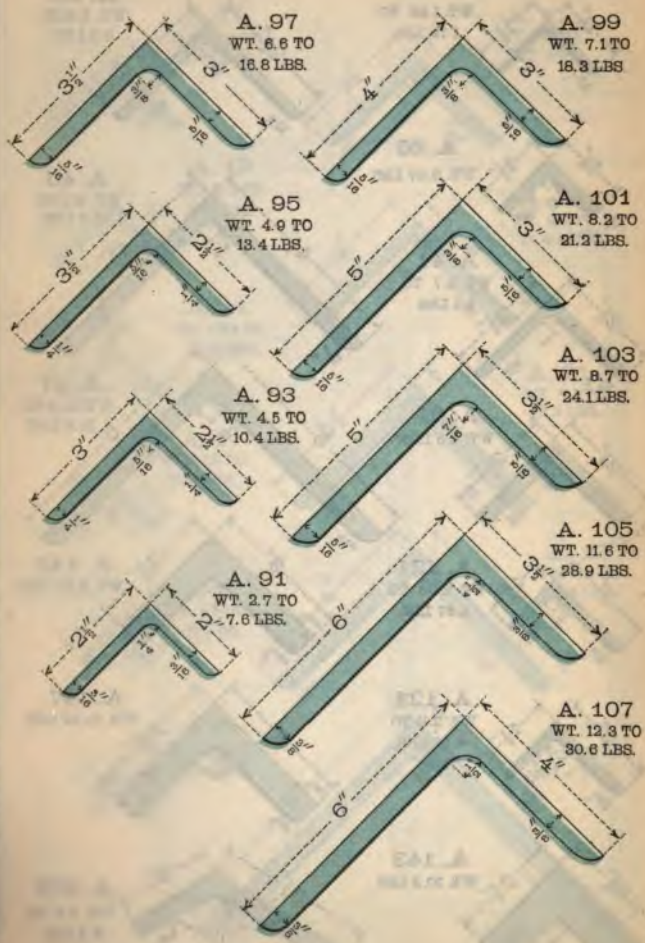

**A. 147**
WT. 10.04 LBS.

**A. 123**
WT. 2.11 TO 4.56 LBS.

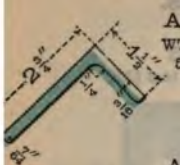
**A. 143**
WT. 10.2 LBS.

**A. 253**
WT. 6.4 TO 8.4 LBS.

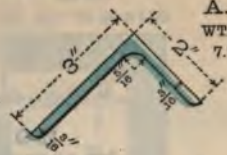
## STANDARD ANGLES WITH UNEQUAL LEGS.



# SPECIAL ANGLES WITH UNEQUAL LEGS.



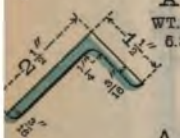

**A. 128**
WT. 2.6 TO 5.7 LBS.




**A. 129**
WT. 3.1 TO 7.7 LBS.

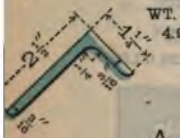
**A. 161**
WT. 2.6 TO 3.4 LBS.

**A. 131**
WT. 7.6 TO 16.0 LBS.

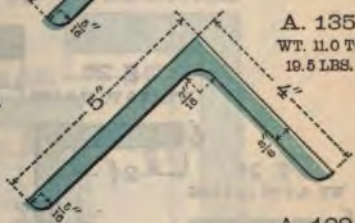



**A. 127**
WT. 2.43 TO 5.30 LBS.

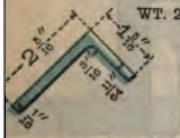
**A. 133**
WT. 9.1 TO 16.0 LBS.




**A. 125**
WT. 2.27 TO 4.93 LBS.

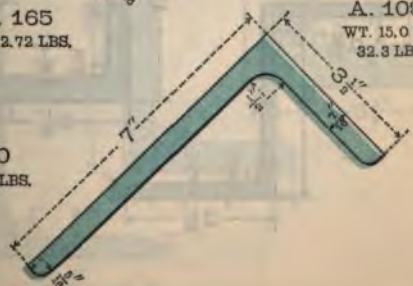



**A. 135**
WT. 11.0 TO 19.5 LBS.




**A. 155**
WT. 2.02 LBS.

**A. 165**
WT. 2.72 LBS.

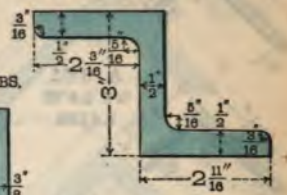



**A. 109**
WT. 15.0 TO 32.3 LBS

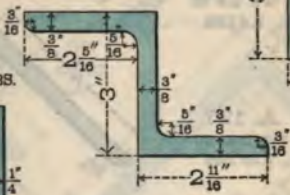
**A 170**
WT. 0.93 LBS.

# STANDARD Z-BARS.

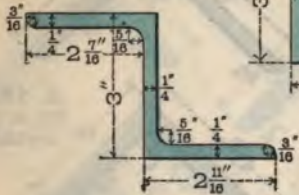
## Z. 13
WT. 12.5 TO 14.2 LBS.



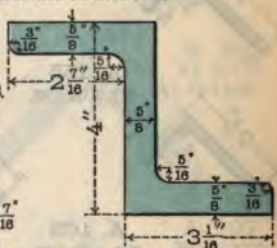

## Z. 9
WT. 9.7 TO 11.4 LBS.



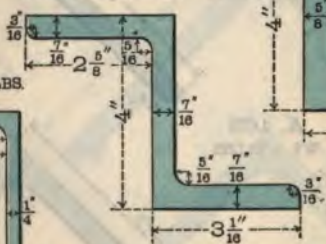

## Z. 5
WT. 6.7 TO 8.4 LBS.



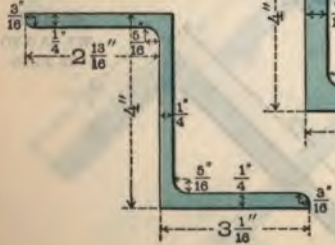

## Z. 29
WT. 18.9 TO 23.0 LBS.



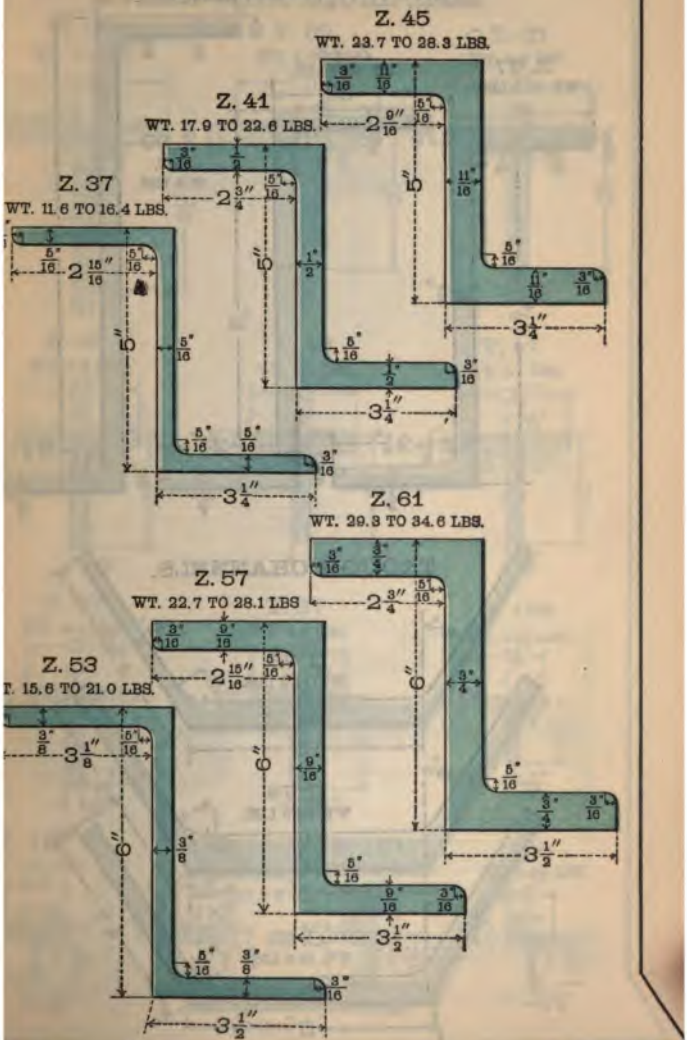

## Z. 25
WT. 13.6 TO 17.9 LBS.



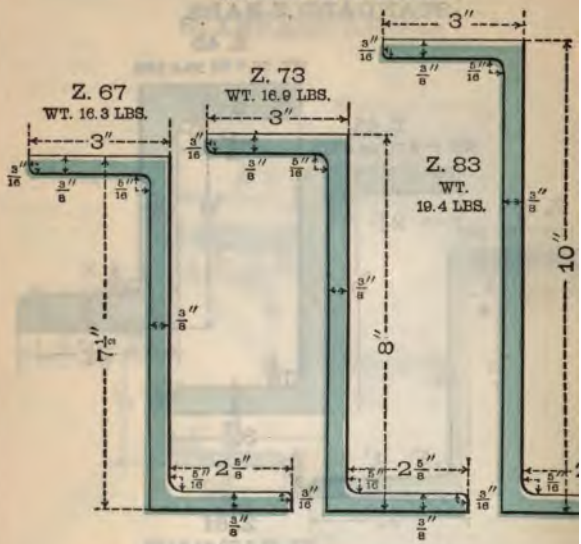

## Z. 21
WT. 8.2 TO 12.4 LBS.



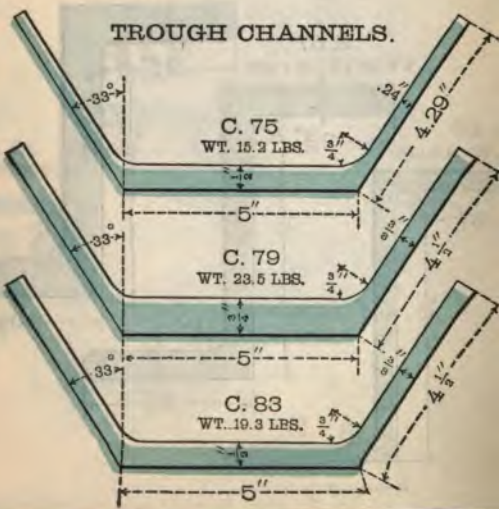
# STANDARD Z-BARS.



## SPECIAL Z-BARS.

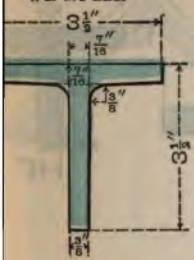



## TROUGH CHANNELS.



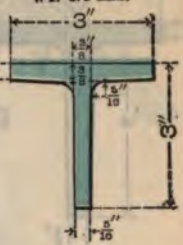
## TEES WITH EQUAL LEGS.

T. 97
WT. 9.3 LBS.

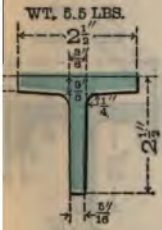


T. 69
WT. 7.8 LBS.

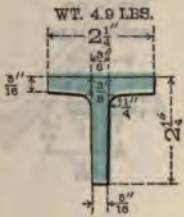
T. 67
WT. 6.6 LBS.



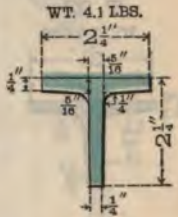
T. 49
WT. 5.5 LBS.



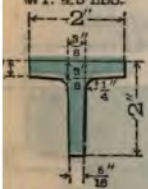
T. 42
WT. 4.9 LBS.



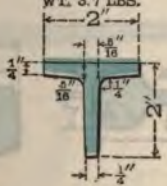
T. 41
WT. 4.1 LBS.



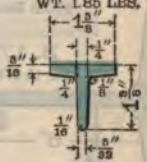
T. 39
WT. 4.3 LBS.



T. 37
WT. 3.7 LBS.



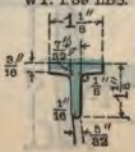
T. 189
WT. 1.85 LBS.



T. 187
T. 1.61 LBS.

T. 183
WT. 1.53 LBS.

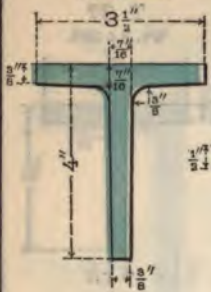
T. 181
WT. 1.39 LBS.



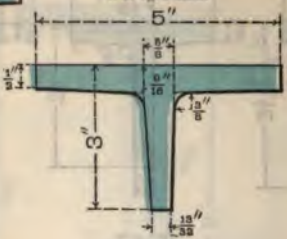
T. 5
WT. 0.89 LBS.

## TEES WITH UNEQUAL LEGS.

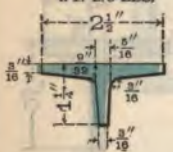
**T. 101**
WT. 9.9 LBS.



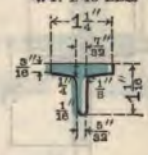

**T. 169**
WT. 13.6 LBS.




**T. 22**
WT. 2.9 LBS.



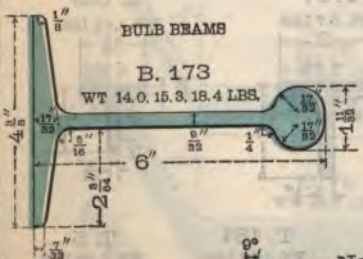

**T. 185**
WT. 1.49 LBS.



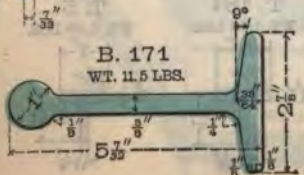

**T. 171**
WT. 7.1 LBS.

**BULB BEAMS**

**B. 173**
WT 14.0, 15.3, 18.4 LBS.

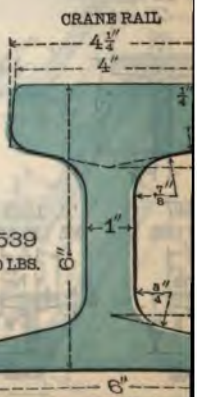



**B. 171**
WT. 11.5 LBS.

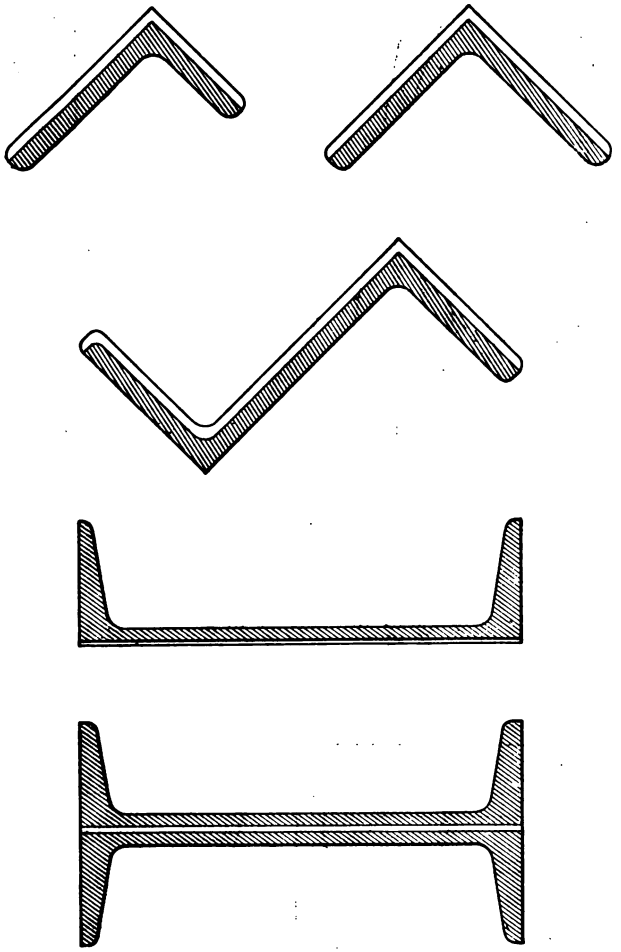



**CRANE RAIL**

**No. 539**
WT. 50 LBS.



## METHOD OF INCREASING SECTIONAL AREAS.



The following Formulas and Diagram relate to the Properties of I Beams.

Weight per foot — Area × 3.4.

Area — $td + 2b(h-t) + \frac{(h-t)^2}{12}$

Section Modulus — $s = \frac{2I}{d}$.

Slope of Flange — $s = \frac{h}{h-t}$ — 1/6 for Standard Beams.

I — Moment of Inertia, Neutral Axis (1-1) parallel to flange.

$I = \frac{1}{12}[bd^3 - \frac{1}{4s}(h-t)^4]$ or $\frac{bd^3}{12}$ 1/6 $(h-t)^4$ for Standard Beams.

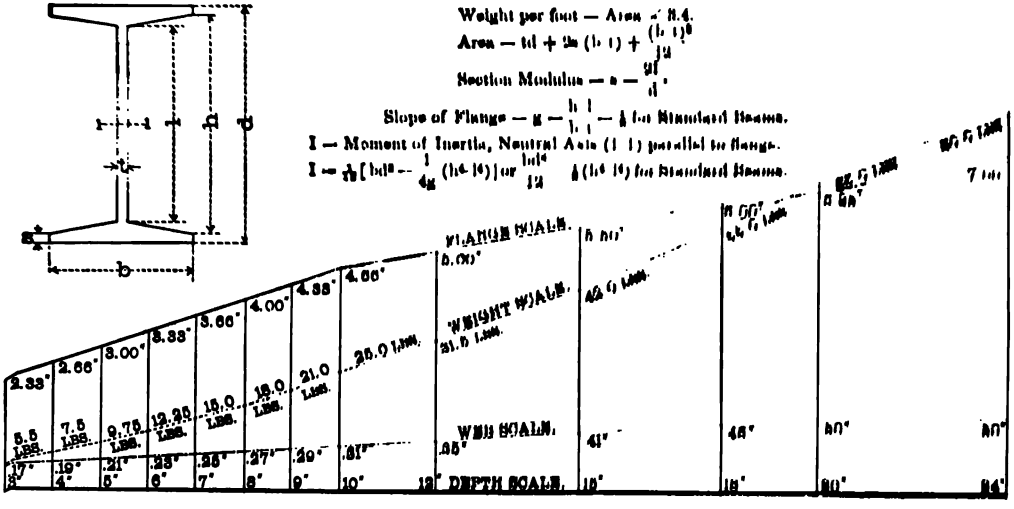



DIAGRAM FOR MINIMUM STANDARD BEAMS.

## STANDARD CHANNELS.

The following Formulas and Diagram relate to the Properties of Channels:

Weight per foot = Area × 3.4.

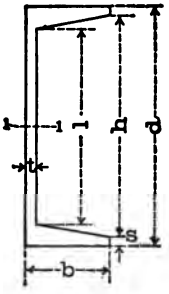
$$\text{Area} = td + 2s\,(b-t) + \frac{(b-t)^3}{6}.$$

$$\text{Section Modulus} = s = \frac{2I}{d}.$$

$$\text{Slope of Flange} = g = \frac{h-l}{2(b-t)}, \text{ or } \tfrac{1}{6} \text{ for Standard Channels.}$$

I = Moment of Inertia, Neutral Axis (1-1) parallel to flange.

$$I = \tfrac{1}{12}\left[bd^3 - \frac{1}{8g}(h^4-l^4)\right] \text{ or } \frac{bd^3}{12} - \frac{h^4-l^4}{16} \text{ for Standard Channels.}$$



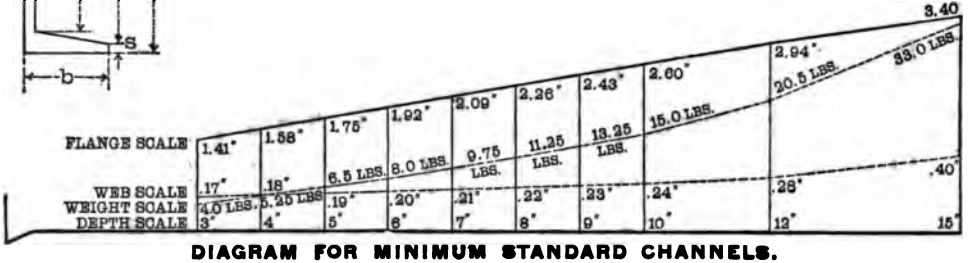
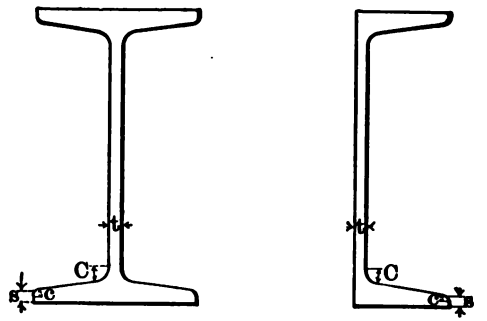




**DIAGRAM FOR MINIMUM STANDARD CHANNELS.**

## STANDARD BEAMS AND CHANNELS.




The following data are common to all I-Beams and Channels, with the exceptions stated:

$c = \frac{s}{10}$ Minimum Web.

C = Minimum Web + $\frac{1}{10}$ inch.

s = Minimum Thickness of Web = t Minimum for all Channels and Beams, except 20″ I and 24″ I.

For 20″ Standard I s = .55″ t Minimum = .50″.

For 24″ Standard I s = .60″ t Minimum = .50″.

For 20″ Special I s = .65″ t Minimum = .60″.

The Slope of Flange of all Beams and Channels is 16⅔ %

= 9° — 27′ — 44″ = 2″ per foot.

# TABLES OF SQUARE, ROUND AND FLAT BARS ROLLED BY CAMBRIA STEEL CO.

## STEEL SQUARES.

All sizes from $\frac{1}{4}''$ to $3\frac{3}{8}''$ increasing by $\frac{1}{16}''$
All sizes from $3\frac{1}{2}''$ to $5\frac{1}{2}''$ increasing by $\frac{1}{8}''$

## STEEL HAND ROUNDS.

All sizes from $\frac{3}{4}''$ to $3\frac{1}{8}''$ increasing by $\frac{1}{16}''$
All sizes from $3\frac{1}{4}''$ to $7\frac{1}{8}''$ increasing by $\frac{1}{8}''$

## STEEL GUIDE ROUNDS.

All sizes from $\frac{5}{16}''$ to $1''$ increasing by $\frac{1}{64}''$
All sizes from $1''$ to $1\frac{1}{2}''$ increasing by $\frac{1}{32}''$
All sizes from $1\frac{1}{2}''$ to $1\frac{3}{4}''$ increasing by $\frac{1}{16}''$
All sizes from $1\frac{3}{4}''$ to $2''$ increasing by $\frac{1}{8}''$

## NUT IRON.

| WIDTH. | THICKNESS. | WEIGHT PER FOOT. | WIDTH. | THICKNESS. | WEIGHT PER FOOT. |
|---|---|---|---|---|---|
| Inches. | Inches. | Pounds. | Inches. | Inches. | Pounds. |
| $\frac{3}{4}$ | $\frac{1}{2}$ | 1.25 | $1\frac{7}{8}$ | $\frac{15}{16}$ | 5.86 |
| $\frac{13}{16}$ | $\frac{9}{16}$ | 1.52 | $1\frac{7}{8}$ | $1\frac{3}{16}$ | 8.59 |
| 1 | $\frac{11}{16}$ | 2.29 | $2\frac{1}{16}$ | $1\frac{7}{16}$ | 10.31 |
| $1\frac{3}{16}$ | $\frac{13}{16}$ | 3.22 | $2\frac{1}{16}$ | $1\frac{5}{8}$ | 12.19 |
| $1\frac{3}{8}$ | $\frac{15}{16}$ | 4.30 | $2\frac{7}{16}$ | $1\frac{13}{16}$ | 14.22 |
| $1\frac{9}{16}$ | $1\frac{1}{16}$ | 5.53 | $2\frac{5}{8}$ | $1\frac{7}{8}$ | 16.41 |
| $1\frac{11}{16}$ | $1\frac{3}{16}$ | 6.68 | | | |

## SQUARE-CORNERED STEEL BILLETS.

$1'' \times 1''$ to $3\frac{1}{4}'' \times 3\frac{1}{4}''$ increasing by $\frac{1}{16}''$

## ROUND-CORNERED STEEL BILLETS.

| SIZE. | APPROXIMATE WEIGHT PER FOOT. | SIZE. | APPROXIMATE WEIGHT PER FOOT. | SIZE. | APPROXIMATE WEIGHT PER FOOT. |
|---|---|---|---|---|---|
| Inches. | Pounds. | Inches. | Pounds. | Inches. | Pounds. |
| 3 x 3 | 31 | $4\frac{1}{2}$ x 4 | 61 | 5 x 5 | 85 |
| $3\frac{1}{2}$ x $3\frac{1}{2}$ | 42 | 5 x $4\frac{1}{2}$ | 77 | $5\frac{1}{2}$ x $5\frac{1}{2}$ | 103 |
| 4 x 4 | 54 | | | | |

## REGULAR FLATS.

| WIDTH. | | THICKNESS. | |
|---|---|---|---|
| Inches. | Increasing by Inches. | Inches. | Increasing by Inches. |
| $\frac{1}{4}$ to $\frac{3}{8}$ | $\frac{1}{64}$ | $\frac{3}{16}$ to $\frac{3}{8}$ | $\frac{1}{64}$ |
| $\frac{15}{32}$ " $\frac{1}{2}$ | " | $\frac{7}{16}$ " $\frac{1}{2}$ | " |
| $\frac{33}{64}$ " 1 | " | $\frac{9}{16}$ " 1 | " |
| $1\frac{1}{32}$ " 2 | $\frac{1}{32}$ | " " 2 | $\frac{1}{32}$ |
| $2\frac{1}{16}$ " 3 | $\frac{1}{16}$ | " " $2\frac{1}{4}$ | " |
| $3\frac{1}{16}$ " $6\frac{1}{2}$ | " | " " $2\frac{3}{4}$ | " |

## THIN FLATS OR LIGHT BANDS.

| | | | |
|---|---|---|---|
| $\frac{1}{2}$ to 6 | $\frac{1}{16}$ | No. 10 to No. 16 ga. | by gau |

## STEEL BLOOMS AND SLABS.

| WIDTH. | THICKNESS. | | WIDTH. | THICKNESS. | |
|---|---|---|---|---|---|
| Inches. | Inches. | Increasing by Inches. | Inches. | Inches. | Increa by Inch |
| 6 | 2 to 6 | $\frac{1}{4}$ | 15 | 2 to 12 | $\frac{1}{4}$ |
| 7 | " " 7 | " | 16 | " " " | " |
| 8 | " " 8 | " | 17 | " " " | " |
| 9 | " " 9 | " | 18 | " " 7 | " |
| 10 | " " 10 | " | 19 | " " 6 | " |
| 11 | " " 11 | " | 20 | " " " | " |
| 12 | " " 12 | " | 21 | " " " | " |
| 13 | " " 13 | " | 22 | " " " | " |
| 14 | " " 14 | " | | | |

## STEEL INGOTS.

| SIZE. | GRADE. |
|---|---|
| STANDARD. | |
| Top, $17\frac{1}{2}$" x $19\frac{3}{4}$"<br>Bottom, $20\frac{1}{2}$" x $22\frac{3}{4}$"<br>6 000 to 7 000 lbs. | BESSEMER OR OPEN HEAR |
| FOR 24" BEAMS. | |
| Top, 19" x 24"<br>Bottom, 22" x 28"<br>9 800 lbs. | BESSEMER OR OPEN HEAR |
| SPECIAL. | |
| 15" to 35" square or round.<br>7 000 to 35 000 lbs.<br>*Maximum length* 18 ft. | OPEN HEARTH. |

## EDGED PLATES.

| Width in Inches. | THICKNESS IN INCHES. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| | MAXIMUM LENGTH IN FEET. | | | | | | | | | | | | | |
| 7 | 25 | 25 | 25 | 25 | 25 | 20 | 20 | 20 | 20 | 20 | 15 | 15 | | |
| 7½ | 25 | 42 | 42 | 42 | 42 | 40 | 40 | 35 | 35 | 30 | 30 | 30 | 30 | 25 |
| 8 | 25 | 42 | 42 | 42 | 42 | 42 | 42 | 34 | 34 | 30 | 30 | 30 | 30 | 25 |
| 9 | 25 | 42 | 42 | 42 | 42 | 42 | 42 | 34 | 34 | 30 | 30 | 30 | 30 | 25 |
| 10 | 25 | 42 | 42 | 42 | 42 | 42 | 42 | 33 | 33 | 30 | 30 | 30 | 30 | 25 |
| 11 | 25 | 42 | 42 | 42 | 42 | 42 | 42 | 33 | 33 | 29 | 29 | 29 | 29 | 24 |
| 12 | 25 | 42 | 42 | 42 | 42 | 42 | 42 | 32 | 32 | 28 | 28 | 28 | 28 | 23 |
| 13 | | 42 | 42 | 42 | 42 | 42 | 42 | 32 | 32 | 27 | 27 | 27 | 27 | 20 |
| 14 | | 42 | 42 | 42 | 42 | 40 | 40 | 30 | 30 | 26 | 26 | 26 | 26 | 20 |
| 14½ | | 42 | 42 | 42 | 42 | 36 | 36 | 30 | 30 | 25 | 25 | 25 | 25 | |

## SHEARED PLATES.

| Width in Inches. | THICKNESS IN INCHES. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
| | MAXIMUM LENGTH IN FEET. | | | | | | | | | | | | | |
| 13 | 20 | 24 | 26 | 28 | 30 | 30 | 30 | 25 | 25 | 20 | 20 | 20 | 20 | 18 |
| 14 | 20 | 24 | 26 | 28 | 30 | 30 | 30 | 25 | 25 | 20 | 20 | 20 | 20 | 18 |
| 15 | 20 | 24 | 26 | 28 | 30 | 30 | 30 | 25 | 25 | 20 | 20 | 20 | 20 | 18 |
| 16 | 20 | 24 | 26 | 28 | 30 | 30 | 30 | 24 | 24 | 20 | 20 | 18 | 15 | 15 |
| 17 | 20 | 24 | 26 | 28 | 30 | 29 | 29 | 23 | 23 | 19 | 19 | 18 | 15 | 15 |
| 18 | 20 | 24 | 26 | 28 | 30 | 28 | 28 | 22 | 22 | 18 | 18 | 16 | 14 | 14 |
| 19 | 20 | 24 | 26 | 28 | 30 | 27 | 27 | 21 | 21 | 16 | 16 | 14 | 14 | 13 |
| 20 | 20 | 24 | 26 | 28 | 28 | 26 | 26 | 20 | 20 | 15 | 15 | 14 | 13 | 12 |
| 21 | 18 | 24 | 26 | 28 | 28 | 25 | 25 | 20 | 20 | 15 | 15 | 14 | 11 | 11 |
| 22 | 18 | 24 | 26 | 28 | 26 | 25 | 25 | 19 | 19 | 14 | 14 | 14 | 11 | 10 |
| 23 | 16 | 24 | 26 | 27 | 26 | 23 | 23 | 16 | 16 | 14 | 14 | 12 | 10 | 9 |
| 24 | 16 | 24 | 26 | 26 | 24 | 20 | 20 | 16 | 16 | 13 | 13 | 12 | 10 | 9 |
| 25 | 16 | 22 | 24 | 26 | 24 | 20 | 20 | 15 | 15 | 11 | 11 | 10 | 9 | 8 |
| 26 | 15 | 22 | 24 | 26 | 22 | 18 | 18 | 15 | 15 | 11 | 11 | 10 | 9 | 8 |
| 27 | 14 | 14 | 24 | 24 | 21 | 18 | 18 | 14 | 14 | 10 | 10 | 10 | 9 | 8 |
| 28 | 14 | 14 | 24 | 24 | 21 | 17 | 17 | 14 | 14 | 10 | 10 | 10 | 9 | 8 |
| 29 | 13 | 13 | 22 | 22 | 20 | 17 | 17 | 13 | 13 | 10 | 10 | 9 | 9 | 8 |
| 30 | 13 | 13 | 22 | 22 | 20 | 17 | 17 | 13 | 13 | 10 | 10 | 9 | 9 | |
| 31 | 13 | 13 | 9 | 8 | 6 | 5 | 4 | 4 | 3 | 3 | | | | |

# WEIGHTS AND DIMENSIONS OF STANDARD I-BEAMS.

| Section Number. | Depth of Beam. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Page Number of Section. |
|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Sq. In. | Inches. | Inches. | |
| B 5 | 3 | 5.5 | 1.63 | .17 | 2.33 | 2 |
| " | " | 6.5 | 1.91 | .26 | 2.42 | " |
| " | " | 7.5 | 2.21 | .36 | 2.52 | " |
| B 9 | 4 | 7.5 | 2.21 | .19 | 2.66 | 2 |
| " | " | 8.5 | 2.50 | .26 | 2.73 | " |
| " | " | 9.5 | 2.79 | .34 | 2.81 | " |
| " | " | 10.5 | 3.09 | .41 | 2.88 | " |
| B 13 | 5 | 9.75 | 2.87 | .21 | 3.00 | 2 |
| " | " | 12.25 | 3.60 | .36 | 3.15 | " |
| " | " | 14.75 | 4.34 | .50 | 3.29 | " |
| B 17 | 6 | 12.25 | 3.61 | .23 | 3.33 | 2 |
| " | " | 14.75 | 4.34 | .35 | 3.45 | " |
| " | " | 17.25 | 5.07 | .47 | 3.57 | " |
| B 21 | 7 | 15.0 | 4.42 | .25 | 3.66 | 2 |
| " | " | 17.5 | 5.15 | .35 | 3.76 | " |
| " | " | 20.0 | 5.88 | .46 | 3.87 | " |
| B 25 | 8 | 18.0 | 5.33 | .27 | 4.00 | 3 |
| " | " | 20.25 | 5.96 | .35 | 4.08 | " |
| " | " | 22.75 | 6.69 | .44 | 4.17 | " |
| " | " | 25.25 | 7.43 | .53 | 4.26 | " |
| B 29 | 9 | 21.0 | 6.31 | .29 | 4.33 | 3 |
| " | " | 25.0 | 7.35 | .41 | 4.45 | " |
| " | " | 30.0 | 8.82 | .57 | 4.61 | " |
| " | " | 35.0 | 10.29 | .73 | 4.77 | " |
| B 33 | 10 | 25.0 | 7.37 | .31 | 4.66 | 3 |
| " | " | 30.0 | 8.82 | .45 | 4.80 | " |
| " | " | 35.0 | 10.29 | .60 | 4.95 | " |
| " | " | 40.0 | 11.76 | .75 | 5.10 | " |
| B 41 | 12 | 31.5 | 9.26 | .35 | 5.00 | 3 |
| " | " | 35.0 | 10.29 | .44 | 5.09 | " |
| " | " | 40.0 | 11.76 | .56 | 5.21 | " |
| B 53 | 15 | 42.0 | 12.48 | .41 | 5.50 | 4 |
| " | " | 45.0 | 13.24 | .46 | 5.55 | " |
| " | " | 50.0 | 14.71 | .56 | 5.65 | " |
| " | " | 55.0 | 16.18 | .66 | 5.75 | " |
| " | " | 60.0 | 17.65 | .75 | 5.84 | " |

## WEIGHTS AND DIMENSIONS OF STANDARD I-BEAMS.

| Section Number. | Depth of Beam. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Page Number of Section. |
|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Sq. In. | Inches. | Inches. | |
| B 65 | 18 | 55.0 | 15.93 | .46 | 6.00 | 6 |
| " | " | 60.0 | 17.65 | .56 | 6.10 | " |
| " | " | 65.0 | 19.12 | .64 | 6.18 | " |
| " | " | 70.0 | 20.59 | .72 | 6.26 | " |
| B 73 | 20 | 65.0 | 19.08 | .50 | 6.25 | 7 |
| " | " | 70.0 | 20.59 | .58 | 6.33 | " |
| " | " | 75.0 | 22.06 | .65 | 6.40 | " |
| B 89 | 24 | 80.0 | 23.32 | .50 | 7.00 | 8 |
| " | " | 85.0 | 25.00 | .57 | 7.07 | " |
| " | " | 90.0 | 26.47 | .63 | 7.13 | " |
| " | " | 95.0 | 27.94 | .69 | 7.19 | " |
| " | " | 100.0 | 29.41 | .75 | 7.25 | " |

## WEIGHTS AND DIMENSIONS OF SPECIAL I-BEAMS.

| Section Number. | Depth of Beam. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Page Number of Section. |
|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Sq. Inches. | Inches. | Inches. | |
| B 105 | 12 | 40.0 | 11.84 | .46 | 5.25 | 4 |
| " | " | 45.0 | 13.24 | .58 | 5.37 | " |
| " | " | 50.0 | 14.71 | .70 | 5.49 | " |
| " | " | 55.0 | 16.18 | .82 | 5.61 | " |
| B 109 | 15 | 60.0 | 17.67 | .59 | 6.00 | 5 |
| " | " | 65.0 | 19.12 | .69 | 6.10 | " |
| " | " | 70.0 | 20.59 | .78 | 6.19 | " |
| " | " | 75.0 | 22.06 | .88 | 6.29 | " |
| " | " | 80.0 | 23.53 | .98 | 6.39 | " |
| B 113 | 15 | 80.0 | 23.57 | .80 | 6.40 | 5 |
| " | " | 85.0 | 25.00 | .90 | 6.50 | " |
| " | " | 90.0 | 26.47 | .99 | 6.59 | " |
| " | " | 95.0 | 27.94 | 1.09 | 6.69 | " |
| " | " | 100.0 | 29.41 | 1.19 | 6.79 | " |
| B 121 | 20 | 80.0 | 23.73 | .60 | 7.00 | 7 |
| " | " | 85.0 | 25.00 | .66 | 7.06 | " |
| " | " | 90.0 | 26.47 | .74 | 7.14 | " |
| " | " | *95.0* | 27.94 | .81 | 7.21 | " |
| " | " | *100.0* | 29.41 | .88 | 7.28 | " |

# WEIGHTS AND DIMENSIONS OF STANDARD CHANNELS.

| Section Number. | Depth of Channel. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Page Number of Section. |
|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Sq. In. | Inches. | Inches. | |
| C 5 | 3 | 4.0 | 1.19 | .17 | 1.41 | 9 |
| " | " | 5.0 | 1.47 | .26 | 1.50 | " |
| " | " | 6.0 | 1.76 | .36 | 1.60 | " |
| C 9 | 4 | 5.25 | 1.55 | .18 | 1.58 | 9 |
| " | " | 6.25 | 1.84 | .25 | 1.65 | " |
| " | " | 7.25 | 2.13 | .33 | 1.73 | " |
| C 13 | 5 | 6.50 | 1.95 | .19 | 1.75 | 9 |
| " | " | 9.00 | 2.65 | .33 | 1.89 | " |
| " | " | 11.50 | 3.38 | .48 | 2.04 | " |
| C 17 | 6 | 8.00 | 2.38 | .20 | 1.92 | 9 |
| " | " | 10.50 | 3.09 | .32 | 2.04 | " |
| " | " | 13.00 | 3.82 | .44 | 2.16 | " |
| " | " | 15.50 | 4.56 | .56 | 2.28 | " |
| C 21 | 7 | 9.75 | 2.85 | .21 | 2.09 | 9 |
| " | " | 12.25 | 3.60 | .32 | 2.20 | " |
| " | " | 14.75 | 4.34 | .42 | 2.30 | " |
| " | " | 17.25 | 5.07 | .53 | 2.41 | " |
| " | " | 19.75 | 5.81 | .63 | 2.51 | " |
| C 25 | 8 | 11.25 | 3.35 | .22 | 2.26 | 10 |
| " | " | 13.75 | 4.04 | .31 | 2.35 | " |
| " | " | 16.25 | 4.78 | .40 | 2.44 | " |
| " | " | 18.75 | 5.51 | .49 | 2.53 | " |
| " | " | 21.25 | 6.25 | .58 | 2.62 | " |
| C 29 | 9 | 13.25 | 3.89 | .23 | 2.43 | 10 |
| " | " | 15.00 | 4.41 | .29 | 2.49 | " |
| " | " | 20.00 | 5.88 | .45 | 2.65 | " |
| " | " | 25.00 | 7.35 | .61 | 2.81 | " |
| C 33 | 10 | 15.0 | 4.46 | .24 | 2.60 | 10 |
| " | " | 20.0 | 5.88 | .38 | 2.74 | " |
| " | " | 25.0 | 7.35 | .53 | 2.89 | " |
| " | " | 30.0 | 8.82 | .68 | 3.04 | " |
| " | " | 35.0 | 10.29 | .82 | 3.18 | " |
| C 41 | 12 | 20.5 | 6.03 | .28 | 2.94 | 10 |
| " | " | 25.0 | 7.35 | .39 | 3.05 | " |
| " | " | 30.0 | 8.82 | .51 | 3.17 | " |
| " | " | 35.0 | 10.29 | .64 | 3.30 | " |
| " | " | 40.0 | 11.76 | .76 | 3.42 | " |

## WEIGHTS AND DIMENSIONS OF STANDARD CHANNELS.

| Section Number. | Depth of Channel. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Page Number of Section. |
|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Sq. Ins. | Inches. | Inches. | |
| C 53 | 15 | 33 | 9.90 | .40 | 3.40 | 11 |
| " | " | 35 | 10.29 | .43 | 3.43 | " |
| " | " | 40 | 11.76 | .52 | 3.52 | " |
| " | " | 45 | 13.24 | .62 | 3.62 | " |
| " | " | 50 | 14.71 | .72 | 3.72 | " |
| " | " | 55 | 16.18 | .82 | 3.82 | " |

## WEIGHTS AND DIMENSIONS OF SPECIAL CHANNELS.

| Section Number. | Depth of Channel | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Thickness of Flange. | Increase in Web and Flange for each pound increase of weight. | Page Number of Section. |
|---|---|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Sq. In. | Inches. | Inches. | Inches. | Inches. | |
| C 73 | 4 | 6.3 | 1.85 | .375 | .375 | .34 | | 11 |
| C 87 | 6 | 14.0 | 4.11 | .28 | 2.96 | .41 | .049 | 11 |
| " | " | 17.0 | 5.00 | .43 | 3.11 | " | " | " |
| " | " | 20.0 | 5.88 | .58 | 3.26 | " | " | " |
| C 91 | 12 | 21.4 | 6.30 | .31 | 2.64 | .34 | .024 | 11 |
| " | " | 23.9 | 7.03 | .37 | 2.70 | " | " | " |
| " | " | 26.4 | 7.77 | .44 | 2.76 | " | " | " |
| " | " | 28.9 | 8.50 | .50 | 2.82 | " | " | " |
| " | " | 31.4 | 9.24 | .56 | 2.89 | " | " | " |
| " | " | 33.9 | 9.97 | .62 | 2.95 | " | " | " |
| C 95 | 13 | 32.0 | 9.26 | .375 | 4.00 | .34 | .023 | 11 |
| " | " | 35.0 | 10.27 | .45 | 4.07 | " | " | " |
| " | " | 40.0 | 11.76 | .56 | 4.19 | " | " | " |
| " | " | 45.0 | 13.24 | .68 | 4.30 | " | " | " |
| " | " | 50.0 | 14.71 | .79 | 4.42 | " | " | " |
| " | " | 55.0 | 16.18 | .90 | 4.53 | " | " | " |
| | Width of Base. | TROUGH CHANNELS. | | | | | | |
| C 75 | 5 | 15.2 | 4.46 | .50 | 4.29 | .24 | | 18 |
| C 79 | " | 23.5 | 6.91 | .75 | 4.50 | .375 | | " |
| C 83 | " | 19.3 | 5.68 | .50 | 4.50 | .375 | | " |

# WEIGHTS AND DIMENSIONS OF STANDARD ANGLES.

## EQUAL LEGS.

| Section Number | Dimensions. Inches. | Thickness. Inches. | Weight per Foot. Pounds. | Area of Section. Sq. In. |
|---|---|---|---|---|
| A 5 | 3/4 x 3/4 | 1/8 | .58 | .17 |
| " | 3/4 x 3/4 | 3/16 | .84 | .25 |
| A 7 | 1 x 1 | 1/8 | .80 | .23 |
| " | 1 x 1 | 3/16 | 1.16 | .34 |
| " | 1 x 1 | 1/4 | 1.49 | .44 |
| A 9 | 1 1/4 x 1 1/4 | 1/8 | 1.02 | .30 |
| " | 1 1/4 x 1 1/4 | 3/16 | 1.47 | .43 |
| " | 1 1/4 x 1 1/4 | 1/4 | 1.91 | .56 |
| " | 1 1/4 x 1 1/4 | 5/16 | 2.32 | .68 |
| A 11 | 1 1/2 x 1 1/2 | 1/8 | 1.23 | .36 |
| " | 1 1/2 x 1 1/2 | 3/16 | 1.79 | .53 |
| " | 1 1/2 x 1 1/2 | 1/4 | 2.34 | .69 |
| " | 1 1/2 x 1 1/2 | 5/16 | 2.86 | .84 |
| " | 1 1/2 x 1 1/2 | 3/8 | 3.35 | .98 |
| " | 1 1/2 x 1 1/2 | 7/16 | 3.81 | 1.12 |
| A 13 | 1 3/4 x 1 3/4 | 3/16 | 2.11 | .62 |
| " | 1 3/4 x 1 3/4 | 1/4 | 2.76 | .81 |
| " | 1 3/4 x 1 3/4 | 5/16 | 3.39 | 1.00 |
| " | 1 3/4 x 1 3/4 | 3/8 | 3.98 | 1.17 |
| " | 1 3/4 x 1 3/4 | 7/16 | 4.56 | 1.34 |
| " | 1 3/4 x 1 3/4 | 1/2 | 5.10 | 1.50 |
| A 15 | 2 x 2 | 3/16 | 2.43 | .71 |
| " | 2 x 2 | 1/4 | 3.19 | .94 |
| " | 2 x 2 | 5/16 | 3.92 | 1.15 |
| " | 2 x 2 | 3/8 | 4.62 | 1.36 |
| " | 2 x 2 | 7/16 | 5.30 | 1.56 |
| " | 2 x 2 | 1/2 | 5.95 | 1.75 |
| A 17 | 2 1/2 x 2 1/2 | 3/16 | 3.1 | .90 |
| " | 2 1/2 x 2 1/2 | 1/4 | 4.0 | 1.19 |
| " | 2 1/2 x 2 1/2 | 5/16 | 5.0 | 1.46 |
| A 17 | 2 1/2 x 2 1/2 | 3/8 | 5.9 | 1.73 |
| " | 2 1/2 x 2 1/2 | 7/16 | 6.8 | 2.00 |
| " | 2 1/2 x 2 1/2 | 1/2 | 7.7 | 2.25 |
| " | 2 1/2 x 2 1/2 | 5/8 | 8.5 | 2.50 |
| A 19 | 3 x 3 | 1/4 | 4.9 | 1.44 |
| " | 3 x 3 | 5/16 | 6.0 | 1.78 |
| " | 3 x 3 | 3/8 | 7.2 | 2.11 |
| " | 3 x 3 | 7/16 | 8.3 | 2.43 |
| " | 3 x 3 | 1/2 | 9.4 | 2.75 |
| " | 3 x 3 | 9/16 | 10.4 | 3.06 |
| " | 3 x 3 | 5/8 | 11.4 | 3.36 |
| " | 3 x 3 | 11/16 | 12.4 | 3.65 |
| A 21 | 3 1/2 x 3 1/2 | 5/16 | 7.1 | 2.09 |
| " | 3 1/2 x 3 1/2 | 3/8 | 8.4 | 2.48 |
| " | 3 1/2 x 3 1/2 | 7/16 | 9.8 | 2.87 |
| " | 3 1/2 x 3 1/2 | 1/2 | 11.1 | 3.25 |
| " | 3 1/2 x 3 1/2 | 9/16 | 12.3 | 3.62 |
| " | 3 1/2 x 3 1/2 | 5/8 | 13.5 | 3.98 |
| " | 3 1/2 x 3 1/2 | 11/16 | 14.8 | 4.34 |
| " | 3 1/2 x 3 1/2 | 3/4 | 15.9 | 4.69 |
| " | 3 1/2 x 3 1/2 | 13/16 | 17.1 | 5.03 |
| " | 3 1/2 x 3 1/2 | 7/8 | 18.3 | 5.36 |
| A 23 | 4 x 4 | 5/16 | 8.2 | 2.40 |
| " | 4 x 4 | 3/8 | 9.7 | 2.86 |
| " | 4 x 4 | 7/16 | 11.3 | 3.31 |
| " | 4 x 4 | 1/2 | 12.8 | 3.75 |
| " | 4 x 4 | 9/16 | 14.2 | 4.18 |
| " | 4 x 4 | 5/8 | 15.7 | 4.61 |
| " | 4 x 4 | 11/16 | 17.1 | 5.03 |
| " | 4 x 4 | 3/4 | 18.5 | 5.44 |
| " | 4 x 4 | 13/16 | 19.9 | 5.84 |
| " | 4 x 4 | 7/8 | 21.2 | 6.23 |

*Standard Angles* vary only by 1/16 inch. Sections shown on page 12.

## WEIGHTS AND DIMENSIONS OF STANDARD ANGLES.

### EQUAL LEGS.—Continued.

| Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. |
|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Inches. | Pounds. | Sq. In. | | Inches. | Inches. | Pounds. | Sq. In. |
| A 27 | 6 x 6 | 13/16 | 14.8 | 4.36 | A 27 | 6 x 6 | 3/4 | 28.7 | 8.44 |
| " | 6 x 6 | 7/8 | 17.2 | 5.06 | " | 6 x 6 | 15/16 | 30.9 | 9.09 |
| " | 6 x 6 | 1 | 19.6 | 5.75 | " | 6 x 6 | 7/8 | 33.1 | 9.73 |
| " | 6 x 6 | 1 1/16 | 21.9 | 6.43 | " | 6 x 6 | 15/16 | 35.3 | 10.37 |
| " | 6 x 6 | 1 1/8 | 24.2 | 7.11 | " | 6 x 6 | 1 | 37.4 | 11.00 |
| " | 6 x 6 | 1 1/16 | 26.4 | 7.78 | | | | | |

Standard Angles vary only by 1/16 inch. Sections shown on page 12.

## WEIGHTS AND DIMENSIONS OF STANDARD ANGLES.

### UNEQUAL LEGS.

| Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. |
|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Inches. | Pounds. | Sq. In. | | Inches. | Inches. | Pounds. | Sq. In. |
| A 91 | 2 1/2 x 2 | 5/16 | 2.7 | .81 | A 95 | 3 1/2 x 2 1/2 | 3/8 | 7.2 | 2.11 |
| " | 2 1/2 x 2 | 1/4 | 3.6 | 1.06 | " | 3 1/2 x 2 1/2 | 7/16 | 8.3 | 2.43 |
| " | 2 1/2 x 2 | 5/16 | 4.5 | 1.31 | " | 3 1/2 x 2 1/2 | 1/2 | 9.4 | 2.75 |
| " | 2 1/2 x 2 | 3/8 | 5.3 | 1.55 | " | 3 1/2 x 2 1/2 | 9/16 | 10.4 | 3.06 |
| " | 2 1/2 x 2 | 7/16 | 6.1 | 1.78 | " | 3 1/2 x 2 1/2 | 5/8 | 11.4 | 3.36 |
| " | 2 1/2 x 2 | 1/2 | 6.8 | 2.00 | " | 3 1/2 x 2 1/2 | 11/16 | 12.4 | 3.65 |
| " | 2 1/2 x 2 | 9/16 | 7.6 | 2.21 | " | 3 1/2 x 2 1/2 | 3/4 | 13.4 | 3.94 |
| A 93 | 3 x 2 1/2 | 1/4 | 4.5 | 1.31 | A 97 | 3 1/2 x 3 | 5/16 | 6.6 | 1.93 |
| " | 3 x 2 1/2 | 5/16 | 5.5 | 1.62 | " | 3 1/2 x 3 | 3/8 | 7.8 | 2.30 |
| " | 3 x 2 1/2 | 3/8 | 6.5 | 1.92 | " | 3 1/2 x 3 | 7/16 | 9.0 | 2.65 |
| " | 3 x 2 1/2 | 7/16 | 7.5 | 2.21 | " | 3 1/2 x 3 | 1/2 | 10.2 | 3.00 |
| " | 3 x 2 1/2 | 1/2 | 8.5 | 2.50 | " | 3 1/2 x 3 | 9/16 | 11.4 | 3.34 |
| " | 3 x 2 1/2 | 9/16 | 9.4 | 2.78 | " | 3 1/2 x 3 | 5/8 | 12.5 | 3.67 |
| " | 3 x 2 1/2 | 5/8 | 10.4 | 3.05 | " | 3 1/2 x 3 | 11/16 | 13.6 | 4.00 |
| | | | | | " | 3 1/2 x 3 | 3/4 | 14.7 | 4.31 |
| A 95 | 3 1/2 x 2 1/2 | 1/4 | 4.9 | 1.44 | " | 3 1/2 x 3 | 13/16 | 15.7 | 4.62 |
| " | 3 1/2 x 2 1/2 | 5/16 | 6.0 | 1.78 | " | 3 1/2 x 3 | 7/8 | 16.8 | 4.92 |

Standard Angles vary only by 1/16 inch. Sections shown on page 14.

# WEIGHTS AND DIMENSIONS OF STANDARD ANGLES.

## UNEQUAL LEGS.—Continued.

| Section Number | Dimensions. Inches. | Thickness. Inches. | Weight per Foot. Pounds. | Area of Section. Sq. In. |
|---|---|---|---|---|
| A 99 | 4 x 3 | 5/16 | 7.1 | 2.09 |
| " | 4 x 3 | 3/8 | 8.4 | 2.48 |
| " | 4 x 3 | 7/16 | 9.8 | 2.87 |
| " | 4 x 3 | 1/2 | 11.1 | 3.25 |
| " | 4 x 3 | 9/16 | 12.3 | 3.62 |
| " | 4 x 3 | 5/8 | 13.5 | 3.98 |
| " | 4 x 3 | 11/16 | 14.8 | 4.34 |
| " | 4 x 3 | 3/4 | 15.9 | 4.69 |
| " | 4 x 3 | 13/16 | 17.1 | 5.03 |
| " | 4 x 3 | 7/8 | 18.3 | 5.36 |
| A 101 | 5 x 3 | 5/16 | 8.2 | 2.40 |
| " | 5 x 3 | 3/8 | 9.7 | 2.86 |
| " | 5 x 3 | 7/16 | 11.3 | 3.31 |
| " | 5 x 3 | 1/2 | 12.8 | 3.75 |
| " | 5 x 3 | 9/16 | 14.2 | 4.18 |
| " | 5 x 3 | 5/8 | 15.7 | 4.61 |
| " | 5 x 3 | 11/16 | 17.1 | 5.03 |
| " | 5 x 3 | 3/4 | 18.5 | 5.44 |
| " | 5 x 3 | 13/16 | 19.9 | 5.84 |
| " | 5 x 3 | 7/8 | 21.2 | 6.23 |
| A 103 | 5 x 3½ | 5/16 | 8.7 | 2.56 |
| " | 5 x 3½ | 3/8 | 10.4 | 3.05 |
| " | 5 x 3½ | 7/16 | 12.0 | 3.53 |
| " | 5 x 3½ | 1/2 | 13.6 | 4.00 |
| " | 5 x 3½ | 9/16 | 15.2 | 4.46 |
| " | 5 x 3½ | 5/8 | 16.7 | 4.92 |
| " | 5 x 3½ | 11/16 | 18.3 | 5.37 |
| A 103 | 5 x 3½ | 3/4 | 19.8 | 5.81 |
| " | 5 x 3½ | 13/16 | 21.2 | 6.25 |
| " | 5 x 3½ | 7/8 | 22.7 | 6.67 |
| " | 5 x 3½ | 15/16 | 24.1 | 7.09 |
| A 105 | 6 x 3½ | 3/8 | 11.6 | 3.42 |
| " | 6 x 3½ | 7/16 | 13.5 | 3.96 |
| " | 6 x 3½ | 1/2 | 15.3 | 4.50 |
| " | 6 x 3½ | 9/16 | 17.1 | 5.03 |
| " | 6 x 3½ | 5/8 | 18.9 | 5.55 |
| " | 6 x 3½ | 11/16 | 20.6 | 6.06 |
| " | 6 x 3½ | 3/4 | 22.3 | 6.56 |
| " | 6 x 3½ | 13/16 | 24.0 | 7.06 |
| " | 6 x 3½ | 7/8 | 25.7 | 7.55 |
| " | 6 x 3½ | 15/16 | 27.3 | 8.03 |
| " | 6 x 3½ | 1 | 28.9 | 8.50 |
| A 107 | 6 x 4 | 3/8 | 12.3 | 3.61 |
| " | 6 x 4 | 7/16 | 14.2 | 4.18 |
| " | 6 x 4 | 1/2 | 16.2 | 4.75 |
| " | 6 x 4 | 9/16 | 18.1 | 5.31 |
| " | 6 x 4 | 5/8 | 19.9 | 5.86 |
| " | 6 x 4 | 11/16 | 21.8 | 6.40 |
| " | 6 x 4 | 3/4 | 23.6 | 6.94 |
| " | 6 x 4 | 13/16 | 25.4 | 7.46 |
| " | 6 x 4 | 7/8 | 27.2 | 7.98 |
| " | 6 x 4 | 15/16 | 28.9 | 8.50 |
| " | 6 x 4 | 1 | 30.6 | 9.00 |

*Standard Angles* vary only by 1/16 inch. Sections shown on page 14.

# WEIGHTS AND DIMENSIONS OF SPECIAL ANGLES.

## EQUAL LEGS.

| Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. |
|---|---|---|---|---|---|---|---|---|
| Inches. | Inches. | Pounds. | Sq. In. | | Inches. | Inches. | Pounds. | Sq. In. |
| 2¼ x 2¼ | 3/16 | 2.7 | .81 | A 45 | 4½ x 4½ | 5/16 | 9.2 | 2.71 |
| 2¼ x 2¼ | 1/4 | 3.6 | 1.06 | " | 4½ x 4½ | 3/8 | 11.0 | 3.23 |
| 2¼ x 2¼ | 5/16 | 4.5 | 1.31 | " | 4½ x 4½ | 7/16 | 12.7 | 3.75 |
| 2¼ x 2¼ | 3/8 | 5.3 | 1.55 | " | 4½ x 4½ | 1/2 | 14.5 | 4.25 |
| 2¼ x 2¼ | 7/16 | 6.1 | 1.78 | " | 4½ x 4½ | 9/16 | 16.1 | 4.75 |
| | | | | " | 4½ x 4½ | 5/8 | 17.8 | 5.23 |
| | | | | " | 4½ x 4½ | 11/16 | 19.5 | 5.71 |
| 2¾ x 2¾ | 3/16 | 3.4 | 1.00 | A 47 | 5 x 5 | 3/8 | 12.3 | 3.61 |
| 2¾ x 2¾ | 1/4 | 4.5 | 1.31 | " | 5 x 5 | 7/16 | 14.2 | 4.18 |
| 2¾ x 2¾ | 5/16 | 5.5 | 1.62 | " | 5 x 5 | 1/2 | 16.2 | 4.75 |
| 2¾ x 2¾ | 3/8 | 6.5 | 1.92 | " | 5 x 5 | 9/16 | 18.1 | 5.31 |
| 2¾ x 2¾ | 7/16 | 7.5 | 2.21 | " | 5 x 5 | 5/8 | 19.9 | 5.86 |
| 2¾ x 2¾ | 1/2 | 8.5 | 2.50 | " | 5 x 5 | 11/16 | 21.8 | 6.40 |

Sections shown on page 13.

# WEIGHTS AND DIMENSIONS OF SPECIAL ANGLES.

## UNEQUAL LEGS.

| Section Number | Dimensions. Inches. | Thickness. Inches. | Weight per Foot. Pounds. | Area of Section. Sq. In. |
|---|---|---|---|---|
| A 170 | 1⅜ x 1/16 | 1/8 | .93 | .27 |
| A 165 | 1¾ x 1⅛ | 5/16 | 2.72 | .80 |
| A 121 | 2 x 1⅜ | 3/16 | 2.03 | .60 |
| " | 2 x 1⅜ | 1/4 | 2.66 | .78 |
| " | 2 x 1⅜ | 5/16 | 3.25 | .96 |
| " | 2 x 1⅜ | 3/8 | 3.83 | 1.13 |
| " | 2 x 1⅜ | 7/16 | 4.37 | 1.29 |
| A 123 | 2 x 1½ | 3/16 | 2.11 | .62 |
| " | 2 x 1½ | 1/4 | 2.76 | .81 |
| " | 2 x 1½ | 5/16 | 3.39 | 1.00 |
| " | 2 x 1½ | 3/8 | 3.98 | 1.17 |
| " | 2 x 1½ | 7/16 | 4.56 | 1.34 |
| A 125 | 2¼ x 1¼ | 3/16 | 2.27 | .67 |
| " | 2¼ x 1¼ | 1/4 | 2.98 | .88 |
| " | 2¼ x 1¼ | 5/16 | 3.65 | 1.07 |
| " | 2¼ x 1¼ | 3/8 | 4.30 | 1.27 |
| " | 2¼ x 1¼ | 7/16 | 4.93 | 1.45 |
| A 127 | 2½ x 1½ | 3/16 | 2.43 | .71 |
| " | 2½ x 1½ | 1/4 | 3.19 | .94 |
| " | 2½ x 1½ | 5/16 | 3.92 | 1.15 |
| " | 2½ x 1½ | 3/8 | 4.62 | 1.36 |
| " | 2½ x 1½ | 7/16 | 5.30 | 1.56 |
| A 161 | 2½ x 1¾ | 3/16 | 2.6 | .76 |
| " | 2½ x 1¾ | 1/4 | 3.4 | 1.00 |
| A 128 | 2¾ x 1½ | 3/16 | 2.6 | .76 |
| " | 2¾ x 1½ | 1/4 | 3.4 | 1.00 |
| " | 2¾ x 1½ | 5/16 | 4.2 | 1.23 |
| " | 2¾ x 1½ | 3/8 | 4.9 | 1.45 |
| " | 2¾ x 1½ | 7/16 | 5.7 | 1.67 |
| A 129 | 3 x 2 | 3/16 | 3.1 | .90 |
| A 129 | 3 x 2 | 1/4 | 4.0 | 1.19 |
| " | 3 x 2 | 5/16 | 5.0 | 1.46 |
| " | 3 x 2 | 3/8 | 5.9 | 1.73 |
| " | 3 x 2 | 7/16 | 6.8 | 2.00 |
| " | 3 x 2 | ½ | 7.7 | 2.25 |
| A 131 | 4 x 3½ | 5/16 | 7.6 | 2.25 |
| " | 4 x 3½ | 3/8 | 9.1 | 2.67 |
| " | 4 x 3½ | 7/16 | 10.5 | 3.09 |
| " | 4 x 3½ | ½ | 11.9 | 3.50 |
| " | 4 x 3½ | 9/16 | 13.3 | 3.90 |
| " | 4 x 3½ | 5/8 | 14.6 | 4.30 |
| " | 4 x 3½ | 11/16 | 16.0 | 4.68 |
| A 133 | 4½ x 3 | 3/8 | 9.1 | 2.67 |
| " | 4½ x 3 | 7/16 | 10.5 | 3.09 |
| " | 4½ x 3 | ½ | 11.9 | 3.50 |
| " | 4½ x 3 | 9/16 | 13.3 | 3.90 |
| " | 4½ x 3 | 5/8 | 14.6 | 4.30 |
| " | 4½ x 3 | 11/16 | 16.0 | 4.68 |
| A 135 | 5 x 4 | 3/8 | 11.0 | 3.23 |
| " | 5 x 4 | 7/16 | 12.7 | 3.75 |
| " | 5 x 4 | ½ | 14.5 | 4.25 |
| " | 5 x 4 | 9/16 | 16.1 | 4.75 |
| " | 5 x 4 | 5/8 | 17.8 | 5.23 |
| " | 5 x 4 | 11/16 | 19.5 | 5.71 |
| A 109 | 7 x 3½ | 7/16 | 15.0 | 4.40 |
| " | 7 x 3½ | ½ | 17.0 | 5.00 |
| " | 7 x 3½ | 9/16 | 19.0 | 5.59 |
| " | 7 x 3½ | 5/8 | 21.0 | 6.17 |
| " | 7 x 3½ | 11/16 | 23.0 | 6.75 |
| " | 7 x 3½ | ¾ | 24.9 | 7.31 |
| " | 7 x 3½ | 13/16 | 26.8 | 7.87 |
| " | 7 x 3½ | ⅞ | 28.7 | 8.42 |
| " | 7 x 3½ | 15/16 | 30.5 | 8.96 |
| " | 7 x 3½ | 1 | 32.3 | 9.50 |

*Sections shown on pages 13 and 15.*

## WEIGHTS AND DIMENSIONS OF REGULAR T-BARS. EQUAL LEGS.

| Width of Flange. | Depth of Bar. | Thickness of Flange. | Thickness of Stem. | Weight per Foot. | Area of Section. | Page Number of Section. |
|---|---|---|---|---|---|---|
| Inches. | Inches. | Inches. | Inches. | Pounds. | Sq. In. | |
| 1 | 1 | 1/8 to 5/32 | 1/8 to 5/32 | 0.89 | .26 | 19 |
| 1 1/8 | 1 1/8 | 3/16 " 7/32 | 5/32 " 7/32 | 1.39 | .41 | " |
| 1 3/16 | 1 3/16 | 3/16 " 1/4 | 5/32 " 7/32 | 1.53 | .45 | " |
| 1 1/4 | 1 1/4 | 3/16 " 1/4 | 5/32 " 1/4 | 1.61 | .47 | " |
| 1 3/8 | 1 3/8 | 3/16 " 1/4 | 5/32 " 1/4 | 1.85 | .54 | " |
| 2 | 2 | 1/4 " 5/16 | 1/4 " 5/16 | 3.7 | 1.05 | " |
| 2 | 2 | 5/16 " 5/16 | 5/16 " 5/16 | 4.3 | 1.26 | " |
| 2 1/4 | 2 1/4 | 5/16 " 5/16 | 5/16 " 5/16 | 4.1 | 1.19 | " |
| 2 1/4 | 2 1/4 | 5/16 " 5/16 | 5/16 " 5/16 | 4.9 | 1.45 | " |
| 2 1/2 | 2 1/2 | 5/16 " 5/16 | 5/16 " 5/16 | 5.5 | 1.60 | " |
| 3 | 3 | 5/16 " 5/16 | 5/16 " 5/16 | 6.6 | 1.95 | " |
| 3 | 3 | 5/16 " 7/16 | 5/16 " 7/16 | 7.8 | 2.27 | " |
| 3 1/2 | 3 1/2 | 5/16 " 7/16 | 5/16 " 7/16 | 9.3 | 2.74 | " |

## WEIGHTS AND DIMENSIONS OF REGULAR T-BARS. UNEQUAL LEGS.

| Width of Flange. | Depth of Bar. | Thickness of Flange. | Thickness of Stem. | Weight per Foot. | Area of Section. | Page Number of Section. |
|---|---|---|---|---|---|---|
| Inches. | Inches. | Inches. | Inches. | Pounds. | Sq In. | |
| 1 1/4 | 1 1/16 | 3/16 to 1/4 | 5/32 to 7/32 | 1.49 | .44 | 20 |
| 2 1/2 | 1 1/4 | 5/16 " 5/16 | 5/16 " 5/16 | 2.9 | .84 | " |
| 3 | 2 1/2 | 5/16 " 7/16 | 5/16 " 7/16 | 7.2 | 2.07 | " |
| 3 1/2 | 4 | 5/16 " 7/16 | 5/16 " 7/16 | 9.9 | 2.91 | " |
| 5 | 3 | 7/16 " 9/16 | 7/16 " 9/16 | 13.6 | 3.93 | " |
| 3 | 2 1/4 | 1/2 | 1/2 | 7.1 | 2.10 | " |

*T marked * is odd.*

## WEIGHTS AND DIMENSIONS OF ODD ANGLES.

### EQUAL LEGS.

| Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. |
|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Inches. | Pounds. | Sq. In. | | Inches. | Inches. | Pounds. | Sq. In. |
| A 61 | $1\frac{1}{2} \times 1\frac{1}{2}$ | $\frac{1}{8}$ | 1.23 | .36 | A 65 | $1\frac{1}{2} \times 1\frac{1}{2}$ | $\frac{7}{16}$ | 2.07 | .61 |
| " | $1\frac{1}{2} \times 1\frac{1}{2}$ | $\frac{3}{16}$ | 1.79 | .53 | A 67 | $2\frac{1}{4} \times 2\frac{1}{4}$ | $\frac{5}{16}$ | 4.4 | 1.27 |

Sections shown on page 13.

## WEIGHTS AND DIMENSIONS OF ODD ANGLES.

### UNEQUAL LEGS.

| Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Section Number | Dimensions. | Thickness. | Weight per Foot. | Area of Section. |
|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Inches. | Pounds. | Sq. In. | | Inches. | Inches. | Pounds. | Sq. In. |
| A 155 | $2\frac{5}{16} \times 1\frac{5}{16}$ | $\frac{1}{4}$ | 2.02 | .59 | A 147 | $3 \times 2\frac{13}{16}$ | $\frac{9}{16}$ | 10.04 | 2.95 |
| A 143 | $2\frac{1}{2} \times 2\frac{1}{4}$ | $\frac{3}{4}$ | 10.2 | 3.0 | A 253 | $3\frac{1}{4} \times 2$ | $\frac{3}{8}$ | 6.4 | 1.88 |
| | | | | | " | $3\frac{1}{4} \times 2$ | $\frac{7}{16}$ | 7.4 | 2.18 |
| A 145 | $3 \times 2\frac{11}{16}$ | $\frac{9}{16}$ | 9.80 | 2.88 | " | $3\frac{1}{4} \times 2$ | $\frac{1}{2}$ | 8.4 | 2.47 |

Sections shown on pages 13 and 15.

## WEIGHTS AND DIMENSIONS.

### BULB BEAMS.

| Section Number. | Depth of Beam. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Diameter of Head. | Page Number of Section. |
|---|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Sq. In. | Inches. | Inches. | Inches. | |
| B 171 | $5\frac{7}{32}$ | 11.5 | 3.37 | $\frac{3}{8}$ | $2\frac{7}{8}$ | 1 | 20 |
| B 173 | 6 | 14.0 | 4.11 | $\frac{13}{32}$ | $4\frac{3}{8}$ | | " |
| " | 6 | 15.3 | 4.48 | $\frac{7}{16}$ | $4\frac{7}{16}$ | | " |
| " | 6 | 18.4 | 5.42 | $\frac{1}{2}$ | $4\frac{15}{32}$ | | " |

# WEIGHTS AND DIMENSIONS OF Z-BARS.

| Section Number. | Depth of Bar. | Length of Legs. | Thickness of Web and Legs. | Weight per Foot. | Area of Section. | Page Number of Section. |
|---|---|---|---|---|---|---|
| | Inches. | Inches. | Inches. | Pounds. | Sq. In. | |
| Z 5 | 3 | $2\frac{11}{16}$ | $\frac{1}{4}$ | 6.7 | 1.97 | 16 |
| " | $3\frac{1}{16}$ | $2\frac{3}{4}$ | $\frac{5}{16}$ | 8.4 | 2.48 | " |
| Z 9 | 3 | $2\frac{11}{16}$ | $\frac{3}{32}$ | 9.7 | 2.86 | 16 |
| " | $3\frac{1}{16}$ | $2\frac{3}{4}$ | $\frac{7}{16}$ | 11.4 | 3.36 | " |
| Z 13 | 3 | $2\frac{11}{16}$ | $\frac{1}{2}$ | 12.5 | 3.69 | 16 |
| " | $3\frac{1}{16}$ | $2\frac{3}{4}$ | $\frac{9}{16}$ | 14.2 | 4.18 | " |
| Z 21 | 4 | $3\frac{1}{16}$ | $\frac{1}{4}$ | 8.2 | 2.41 | 16 |
| " | $4\frac{1}{16}$ | $3\frac{1}{8}$ | $\frac{5}{16}$ | 10.3 | 3.03 | " |
| " | $4\frac{1}{8}$ | $3\frac{3}{16}$ | $\frac{3}{8}$ | 12.4 | 3.66 | " |
| Z 25 | 4 | $3\frac{1}{16}$ | $\frac{7}{16}$ | 13.8 | 4.05 | 16 |
| " | $4\frac{1}{16}$ | $3\frac{1}{8}$ | $\frac{1}{2}$ | 15.8 | 4.66 | " |
| " | $4\frac{1}{8}$ | $3\frac{3}{16}$ | $\frac{9}{16}$ | 17.9 | 5.27 | " |
| Z 29 | 4 | $3\frac{1}{16}$ | $\frac{5}{8}$ | 18.9 | 5.55 | 16 |
| " | $4\frac{1}{16}$ | $3\frac{1}{8}$ | $\frac{11}{16}$ | 20.9 | 6.14 | " |
| " | $4\frac{1}{8}$ | $3\frac{3}{16}$ | $\frac{3}{4}$ | 23.0 | 6.75 | " |
| Z 37 | 5 | $3\frac{1}{4}$ | $\frac{5}{16}$ | 11.6 | 3.40 | 17 |
| " | $5\frac{1}{16}$ | $3\frac{5}{16}$ | $\frac{3}{32}$ | 13.9 | 4.10 | " |
| " | $5\frac{1}{8}$ | $3\frac{3}{8}$ | $\frac{7}{16}$ | 16.4 | 4.81 | " |
| Z 41 | 5 | $3\frac{1}{4}$ | $\frac{1}{2}$ | 17.9 | 5.25 | 17 |
| " | $5\frac{1}{16}$ | $3\frac{5}{16}$ | $\frac{9}{16}$ | 20.2 | 5.94 | " |
| " | $5\frac{1}{8}$ | $3\frac{3}{8}$ | $\frac{5}{8}$ | 22.6 | 6.64 | " |
| Z 45 | 5 | $3\frac{1}{4}$ | $\frac{11}{16}$ | 23.7 | 6.96 | 17 |
| " | $5\frac{1}{16}$ | $3\frac{5}{16}$ | $\frac{3}{4}$ | 26.0 | 7.64 | " |
| " | $5\frac{1}{8}$ | $3\frac{3}{8}$ | $\frac{13}{16}$ | 28.3 | 8.33 | " |
| Z 53 | 6 | $3\frac{1}{2}$ | $\frac{3}{32}$ | 15.6 | 4.59 | 17 |
| " | $6\frac{1}{16}$ | $3\frac{9}{16}$ | $\frac{7}{16}$ | 18.3 | 5.39 | " |
| " | $6\frac{1}{8}$ | $3\frac{5}{8}$ | $\frac{1}{2}$ | 21.0 | 6.19 | " |
| Z 57 | 6 | $3\frac{1}{2}$ | $\frac{9}{16}$ | 22.7 | 6.68 | 17 |
| " | $6\frac{1}{16}$ | $3\frac{9}{16}$ | $\frac{5}{8}$ | 25.4 | 7.46 | " |
| " | $6\frac{1}{8}$ | $3\frac{5}{8}$ | $\frac{11}{16}$ | 28.1 | 8.25 | " |
| Z 61 | 6 | $3\frac{1}{2}$ | $\frac{3}{4}$ | 29.3 | 8.63 | 17 |
| " | $6\frac{1}{16}$ | $3\frac{9}{16}$ | $\frac{13}{16}$ | 31.9 | 9.39 | " |
| " | $6\frac{1}{8}$ | $3\frac{5}{8}$ | $\frac{7}{8}$ | 34.6 | 10.17 | " |
| Z 67 | $7\frac{1}{2}$ | 3 | $\frac{3}{8}$ | 16.3 | 4.78 | 18 |
| Z 73 | 8 | 3 | $\frac{3}{8}$ | 16.9 | 4.97 | 18 |
| Z 83 | 10 | 3 | $\frac{3}{8}$ | 19.4 | 5.72 | 18 |

## STANDARD CONNECTION ANGLES FOR I-BEAMS AND CHANNELS.

Standard angle connections for all sizes of beams and channels are shown on page 43. These are of sufficient strength for all usual connections of the various sizes shown, figured on the basis of 10 000 pounds per square inch, as the allowable unit stress for single shear of rivets or bolts, and 20 000 pounds per square inch as the allowable unit stress for double shear and bearing value of the parts connected by the rivets.

When beams of very short spans are loaded to their full capacity, the end shear or reaction which has to be transmitted through the connections becomes so great that stronger connections than the standard should be used.

The following tables give the limits of length below which the standard connections do not apply and for which special designs should be made. For all lengths greater than those given in the tables the standard connections are sufficiently strong.

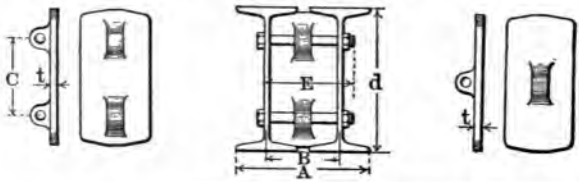
## MINIMUM SPANS OF STANDARD CHANNELS FOR WHICH STANDARD CONNECTION ANGLES MAY BE SAFELY USED WITH CHANNELS UNIFORMLY LOADED TO THEIR FULL CAPACITY, IN ACCORDANCE WITH TABLES OF SAFE LOADS, FOR FIBER STRESS OF 16 000 LBS. PER SQUARE INCH.

| Section Number | Depth of Channel. | Weight per Foot. | Minimum Safe Span. | Section Number | Depth of Channel. | Weight per Foot. | Minimum Safe Span. | Section Number | Depth of Channel. | Weight per Foot. | Minimum Safe Span. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Feet. | | Inches. | Pounds. | Feet. | | Inches. | Pounds. | Feet. |
| C 5 | 3 | 4.0 | 1.1 | C 21 | 7 | 12.25 | 2.6 | C 33 | 10 | 25.0 | 5.5 |
| " | " | 5.0 | 0.8 | " | " | 14.75 | 2.3 | " | " | 30.0 | 6.2 |
| " | " | 6.0 | 0.8 | " | " | 17.25 | 2.6 | " | " | 35.0 | 7.0 |
| | | | | " | " | 19.75 | 2.9 | | | | |
| C 9 | 4 | 5.25 | 1.9 | | | | | | | | |
| " | " | 6.25 | 1.5 | C 25 | 8 | 11.25 | 4.4 | C 41 | 12 | 20.5 | 5.4 |
| " | " | 7.25 | 1.4 | " | " | 13.75 | 3.4 | " | " | 25.0 | 4.8 |
| | | | | " | " | 16.25 | 3.0 | " | " | 30.0 | 5.4 |
| C 13 | 5 | 6.5 | 2.8 | " | " | 18.75 | 3.3 | " | " | 35.0 | 6.0 |
| " | " | 9.0 | 2.1 | " | " | 21.25 | 3.6 | " | " | 40.0 | 6.6 |
| " | " | 11.5 | 2.5 | | | | | | | | |
| | | | | C 29 | 9 | 13.25 | 5.4 | | | | |
| C 17 | 6 | 8.0 | 3.9 | " | " | 15.00 | 4.6 | C 53 | 15 | 33.0 | 7.4 |
| " | " | 10.5 | 3.0 | " | " | 20.00 | 4.1 | " | " | 35.0 | 7.1 |
| " | " | 13.0 | 3.5 | " | " | 25.00 | 4.7 | " | " | 40.0 | 7.0 |
| " | " | 15.5 | 3.9 | | | | | " | " | 45.0 | 7.5 |
| | | | | C 33 | 10 | 15.0 | 6.6 | " | " | 50.0 | 8.1 |
| C 21 | 7 | 9.75 | 3.4 | " | " | 20.0 | 4.9 | " | " | 55.0 | 8.7 |

## NIMUM SPANS OF I-BEAMS FOR WHICH TANDARD CONNECTION ANGLES MAY BE SAFELY USED WITH I-BEAMS UNIFORMLY LOADED TO THEIR FULL CAPACITY, IN ACCORDANCE WITH TABLES OF SAFE LOADS, FOR FIBER STRESS OF 16 000 LBS. PER SQUARE INCH.

| Depth of Beam. | Weight per Foot. | Minimum Safe Span. | Section Number | Depth of Beam. | Weight per Foot. | Minimum Safe Span. | Section Number | Depth of Beam. | Weight per Foot. | Minimum Safe Span. |
|---|---|---|---|---|---|---|---|---|---|---|
| Inches. | Pounds. | Feet. | | Inches. | Pounds. | Feet. | | Inches. | Pounds. | Feet. |
| 3 | 5.5 | 1.7 | B29 | 9 | 30.0 | 6.8 | B113 | 15 | 80.0 | 15.9 |
| " | 6.5 | 1.2 | " | " | 35.0 | 7.5 | " | " | 85.0 | 16.4 |
| " | 7.5 | 1.2 | | | | | " | " | 90.0 | 17.0 |
| | | | B33 | 10 | 25.0 | 9.3 | " | " | 95.0 | 17.5 |
| 4 | 7.5 | 2.8 | " | " | 30.0 | 8.1 | " | " | 100.0 | 18.1 |
| " | 8.5 | 2.2 | " | " | 35.0 | 8.8 | | | | |
| " | 9.5 | 2.0 | " | " | 40.0 | 9.6 | B65 | 18 | 55.0 | 13.7 |
| " | 10.5 | 2.2 | | | | | " | " | 60.0 | 11.9 |
| | | | B41 | 12 | 31.5 | 7.3 | " | " | 65.0 | 11.8 |
| 5 | 9.75 | 4.1 | " | " | 35.0 | 7.7 | " | " | 70.0 | 12.4 |
| " | 12.25 | 3.3 | " | " | 40.0 | 8.2 | | | | |
| " | 14.75 | 3.7 | | | | | B73 | 20 | 65.0 | 13.9 |
| | | | B105 | 12 | 40.0 | 9.0 | " | " | 70.0 | 12.5 |
| 6 | 12.25 | 5.6 | " | " | 45.0 | 9.6 | " | " | 75.0 | 12.8 |
| " | 14.75 | 4.8 | " | " | 50.0 | 10.2 | | | | |
| " | 17.25 | 5.3 | " | " | 55.0 | 10.8 | B121 | 20 | 80.0 | 14.8 |
| | | | | | | | " | " | 85.0 | 15.2 |
| 7 | 15.00 | 4.9 | B53 | 15 | 42.0 | 10.2 | " | " | 90.0 | 15.7 |
| " | 17.50 | 3.8 | " | " | 45.0 | 9.4 | " | " | 95.0 | 16.2 |
| " | 20.00 | 3.6 | " | " | 50.0 | 9.7 | " | " | 100.0 | 16.7 |
| | | | " | " | 55.0 | 10.3 | | | | |
| 8 | 18.00 | 6.2 | " | " | 60.0 | 10.8 | B89 | 24 | 80.0 | 17.7 |
| " | 20.25 | 5.1 | | | | | " | " | 85.0 | 16.1 |
| " | 22.75 | 4.8 | B109 | 15 | 60.0 | 12.3 | " | " | 90.0 | 16.1 |
| " | 25.25 | 5.1 | " | " | 65.0 | 12.8 | " | " | 95.0 | 16.6 |
| | | | " | " | 70.0 | 13.4 | " | " | 100.0 | 17.1 |
| 9 | 21.0 | 7.7 | " | " | 75.0 | 13.9 | | | | |
| " | 25.0 | 6.2 | " | " | 80.0 | 14.5 | | | | |

## CAST IRON SEPARATORS FOR I-BEAMS.

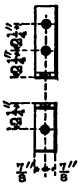



| Section Number | Beams. Depth. d | Weight per Foot. | Out to Out of Flanges of Beams. A | Center to Center of Beams. B | Separators. Thickness. t | Weight. | Increase of Weight for each inch additional spread of Beams. | Bolts, Square Heads and Hex Nuts. Diameter. | Center to Center of Bolts. C | Length. E | Weight of Bolts and Nuts. | Increase of Weight of Bolts for each inch additional spread of Beams. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | In. | Pounds. | Inches. | Inches. | In. | Pounds. | Pounds. | In. | In. | In. | Pounds. | Pounds |
| **SEPARATORS WITH ONE BOLT.** | | | | | | | | | | | | |
| B 5 | 3 | 5.5 | $5\frac{5}{16}$ | 3 | $\frac{3}{16}$ | 1.1 | .29 | $\frac{5}{8}$ | | $3\frac{7}{8}$ | .94 | .085 |
| B 9 | 4 | 7.5 | $5\frac{7}{8}$ | $3\frac{1}{2}$ | " | 1.6 | .38 | " | | $4\frac{1}{4}$ | .98 | .123 |
| B 13 | 5 | 9.75 | $6\frac{1}{2}$ | $3\frac{1}{2}$ | " | 2.0 | .49 | " | | $4\frac{1}{2}$ | 1.01 | " |
| B 17 | 6 | 12.25 | $7\frac{5}{16}$ | 4 | $\frac{1}{2}$ | 3.3 | .78 | " | | 5 | 1.07 | " |
| B 21 | 7 | 15.0 | $7\frac{7}{8}$ | $4\frac{1}{2}$ | " | 3.9 | .92 | " | | $5\frac{1}{4}$ | 1.10 | " |
| B 25 | 8 | 18.0 | $8\frac{1}{2}$ | $4\frac{1}{2}$ | " | 4.7 | 1.06 | " | | $5\frac{5}{8}$ | 1.15 | " |
| B 29 | 9 | 21.0 | $9\frac{5}{16}$ | 5 | " | 5.9 | 1.20 | " | | $6\frac{1}{8}$ | 1.21 | " |
| B 33 | 10 | 25.0 | $9\frac{7}{8}$ | $5\frac{1}{4}$ | " | 6.8 | 1.33 | " | | $6\frac{5}{8}$ | 1.24 | " |
| B 41 | 12 | 31.5 | $10\frac{3}{4}$ | $5\frac{3}{4}$ | " | 8.8 | 1.61 | " | | $6\frac{7}{8}$ | 1.30 | " |
| B105 | 12 | 40.0 | $11\frac{1}{4}$ | 6 | " | 8.9 | 1.58 | " | | $7\frac{1}{4}$ | 1.35 | " |
| **SEPARATORS WTH TWO BOLTS.** | | | | | | | | | | | | |
| B 41 | 12 | 31.5 | $10\frac{3}{4}$ | $5\frac{3}{4}$ | $\frac{1}{2}$ | 9.5 | 1.61 | $\frac{3}{4}$ | $6\frac{1}{2}$ | $6\frac{7}{8}$ | 2.61 | .246 |
| B105 | 12 | 40.0 | $11\frac{1}{4}$ | 6 | " | 9.5 | 1.58 | " | " | $7\frac{1}{4}$ | 2.70 | " |
| B 53 | 15 | 42.0 | $11\frac{3}{4}$ | $6\frac{1}{4}$ | " | 12.5 | 2.02 | " | 7 | $7\frac{1}{2}$ | 2.76 | " |
| B109 | 15 | 60.0 | $12\frac{3}{4}$ | $6\frac{3}{4}$ | " | 13.0 | 1.97 | " | " | $8\frac{1}{2}$ | 2.92 | " |
| B113 | 15 | 80.0 | $13\frac{3}{4}$ | $7\frac{1}{4}$ | " | 13.2 | 1.91 | " | " | $8\frac{1}{2}$ | 3.10 | " |
| B 65 | 18 | 55.0 | $12\frac{3}{4}$ | $6\frac{3}{4}$ | $\frac{5}{16}$ | 19.8 | 2.41 | " | 9 | 8 | 2.89 | " |
| B 73 | 20 | 65.0 | $13\frac{1}{4}$ | 7 | " | 22.9 | 3.37 | $\frac{7}{8}$ | 10 | $8\frac{3}{8}$ | 4.20 | .334 |
| B121 | 20 | 80.0 | $14\frac{3}{4}$ | $7\frac{3}{4}$ | " | 24.6 | 3.34 | " | " | $9\frac{1}{4}$ | 4.49 | " |
| B 89 | 24 | 80.0 | $14\frac{3}{4}$ | $7\frac{3}{4}$ | " | 30.3 | 4.07 | " | 12 | $9\frac{1}{8}$ | 4.45 | " |

Lengths and weights of separator bolts in above table are for girders composed of two beams of minimum section as shown. Lengths of bolts for intermediate and *maximum sizes of beams* may be obtained by adding twice the increase of web *thickness to the lengths given.*

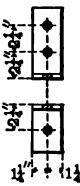
# STANDARD CONNECTION ANGLES FOR I-BEAMS AND CHANNELS.

FOR 3″ AND 4″ BEAMS AND CHANNELS



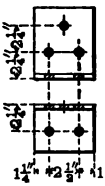
c 4″ x ⅝″ ANGLE - 1¾″ LONG

FOR 5″ AND 6″ BEAMS AND CHANNELS



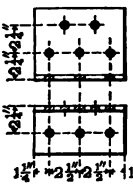
6″ x 4″ x ⅝″ ANGLE - 2½″ LONG

FOR 7″, 8″, 9″ AND 10″ BEAMS AND CHANNELS



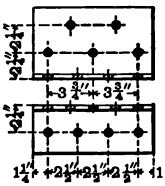
6″ x 4″ x ⅝″ ANGLE - 5″ LONG

2″ BEAMS AND CHANNELS



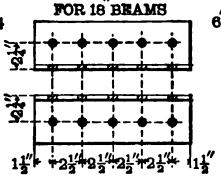
: 4″ x ⅝″ ANGLE - 7½″ LONG

FOR 15″ BEAMS AND CHANNELS



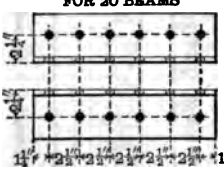
6″ x 4″ x ⅝″ ANGLE - 10″ LONG

FOR 18″ BEAMS



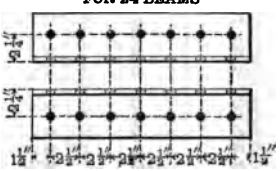
4″ x 4″ x ⅝″ ANGLE - 13″ LONG

FOR 20″ BEAMS



4″ x 4″ x ⅝″ ANGLE - 15″ LONG

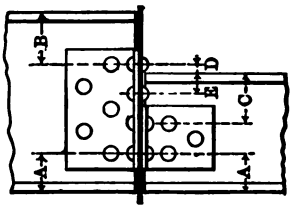
FOR 24″ BEAMS



4″ x 4″ x ⅝″ ANGLE - 18″ LONG

RIVETS OR BOLTS TO BE ¾″ DIAMETER. ALL OPEN HOLES TO BE 15/16″ DIAMETER.

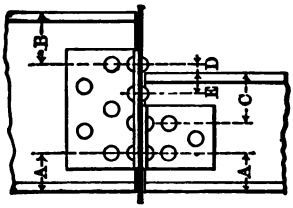
# LOCATION OF CONNECTION ANGLES FOR BEAMS OF THE SAME OR DIFFERENT SIZES FRAMING OPPOSITE, BOTTOMS OR TOPS FLUSH.




| DEPTH OF BEAMS. Inches. | | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Main Beam. | Opposite Beam. | Inches. | Inches. | Inches. | Inches. | Inches. |
| 3 | 3 | 1½ | 1½ | 1½ | . . | . . |
| 4 | 3 | 1½ | 2½ | 1½ | . . | . . |
| " | 4 | 2 | 2 | 2 | . . | . . |
| 5 | 4 | 2 | 3 | 2 | . . | . . |
| " | 5 | 2½ | 2½ | 2½ | . . | . . |
| 6 | 4 | 2 | 4 | 2 | . . | . . |
| " | 5 | " | " | 3 | . . | . . |
| " | 6 | 3 | 3 | 3 | . . | . . |
| 7 | 4 | 2½ | 2 | 1½ | 1 | 1½ |
| " | 5 | " | " | 2½ | 0 | 0 |
| " | 6 | " | " | 3½ | . . | 1 |
| " | 7 | 2¼ | 2¼ | 2½ | . . | . . |
| 8 | 4 | 2½ | 3 | 1½ | 1 | 1½ |
| " | 5 | " | " | 2½ | 0 | 0 |
| " | 6 | " | " | 3½ | . . | 1 |
| " | 7 | " | " | 3 | . . | 2 |
| " | 8 | 2¾ | 2¾ | 2¾ | . . | . . |
| 9 | 5 | 2½ | 4 | 2½ | 0 | 0 |
| " | 6 | " | " | 3½ | . . | 1 |
| " | 7 | " | " | 3 | . . | . . |
| " | 8 | " | " | 3 | . . | . . |
| " | 9 | 3¼ | 3¼ | 3¼ | . . | . . |
| 10 | 6 | 2½ | 5 | 3½ | . . | 1 |
| " | 7 | " | " | 3 | . . | 2 |
| " | 8 | " | " | 3 | . . | 3 |
| " | 9 | " | " | 4 | . . | 4 |
| " | 10 | 3¾ | 3¾ | 3¾ | . . | . . |

*For cases where D is* zero or E is 1" or zero cut beam back ½" or cope flange back ⅛" *to clear rivet head.*

# LOCATION OF CONNECTION ANGLES FOR BEAMS OF THE SAME OR DIFFERENT SIZES FRAMING OPPOSITE, BOTTOMS OR TOPS FLUSH.




| DEPTH OF BEAMS. Inches. | | A | B | C | D | E |
|---|---|---|---|---|---|---|
| Main Beam. | Opposite Beam. | Inches. | Inches. | Inches. | Inches. | Inches. |
| 12 | 8 | 3¼ | 3¾ | 2¼ | ¼ | 2¼ |
| " | 9 | " | " | 3⅛ | .. | 5/8 |
| " | 10 | " | " | 4⅛ | .. | 1¾ |
| " | 12 | 3½ | 3½ | 3½ | .. | .. |
| 15 | 8 | 3¼ | 4¼ | 2¼ | ¼ | 2¼ |
| " | 9 | " | " | 3⅛ | 1⅝ | 5/8 |
| " | 10 | " | " | 4⅛ | 5/8 | 1¾ |
| " | 12 | " | " | 3⅝ | ¼ | 1⅛ |
| " | 15 | 3¾ | 3¾ | 3¾ | .. | 1¼ |
| 18 | 8 | 3¼ | 4¾ | 2¼ | ¼ | 2¼ |
| " | 9 | " | " | 3⅛ | 1⅝ | 5/8 |
| " | 10 | " | " | 4⅛ | 5/8 | 1¾ |
| " | 12 | " | " | 3⅝ | 1⅛ | 1⅛ |
| " | 15 | " | " | 4¼ | .. | 1¼ |
| " | 18 | 4 | 4 | 4 | .. | .. |
| 20 | 8 | 3¼ | 4¼ | 2¼ | ¼ | 2¼ |
| " | 9 | " | " | 3⅛ | 1⅝ | 5/8 |
| " | 10 | " | " | 4⅛ | 5/8 | 1¾ |
| " | 12 | " | " | 3⅝ | 1⅛ | 1⅛ |
| " | 15 | " | " | 4¼ | 5/8 | 1¼ |
| " | 18 | " | " | 4⅝ | .. | 2¼ |
| " | 20 | 3¾ | 3¾ | 3¾ | .. | .. |
| 24 | 8 | 3¼ | 5¾ | 2¼ | ¼ | 2¼ |
| " | 9 | " | " | 3⅛ | 1⅝ | 5/8 |
| " | 10 | " | " | 4⅛ | 5/8 | 1¾ |
| " | 12 | " | " | 3⅝ | 1⅛ | 1⅛ |
| " | 15 | " | " | 4¼ | 5/8 | 1¼ |
| " | 18 | " | " | 4⅝ | ¼ | 2¼ |
| " | 20 | " | " | 4¼ | .. | 1¾ |
| " | 24 | 4½ | 4½ | 4½ | .. | .. |

For cases where **D** is ¼" or ¾" or **E** is ¾" or 1¼" cut beam back ½" or cope angles back ½" to clear rivet head.

## BEARING PLATES FOR SHAPES USED AS BEAMS.

Shapes used as beams resting on masonry walls or piers will generally require bearing plates of steel or their equivalents, set in or upon the masonry to properly distribute the load thereon with due regard to the allowable safe pressures for the class of stonework or brickwork in question.

A table of bearing plates is presented on page 47, which gives the bearing values in pounds for plates of various sizes based on the safe unit pressure allowable on different classes of masonry. As the strength of masonry varies largely dependent upon the qualities of the material used, the workmanship and age, it is impossible to present absolute figures for safe unit pressures for all classes of work, but the values given below are believed to fairly represent these for the usual kinds of ordinary architectural masonry. The strength of ordinary masonry generally depends upon the crushing value of the mortar or cement used and does not bear any fixed relation to the ultimate strength of the brick or stone entering into the construction.

The table of bearing plates gives the bearing values of various sizes of plates when used with different classes of masonry, but the thickness of the plate should be computed for each case.

For a plate of given length and breadth the thickness depends upon the allowable load and unit stress, and the width of the flange of the beam or channel resting upon it.

The thickness may be determined by the following formula:

$$t = .866\,(l - b)\sqrt{\frac{R}{pb'l}}$$

t = thickness of plate in inches.
l = length of plate in a direction perpendicular to the axis of the beam or channel in inches.
b = width of flange of beam or channel in inches.
R = reaction at point of support in pounds.
For uniformly distributed loads R = one-half of the load given in Tables of Safe Loads, pages 77 to 93 inclusive.
p = allowable stress in pounds per square inch on extreme fibre of plate.
b′ = width of plate in the direction of the axis of the beam or channel; *i. e.*, bearing on wall in inches.

If p = 16 000 lbs. for steel we have

$$t = .00685\,(l - b)\sqrt{\frac{R}{b'l}}$$

### Examples.

What is the proper size of steel bearing plate to be used in a wall of good brick laid in lime mortar to support the end of a 10-inch standard I-Beam, weighing 25 pounds per foot, of 16-foot span, subjected to its safe load uniformly distributed?

On page 80 in the Table of Safe Loads Uniformly Distributed for Cambria I-Beams, the total load is found to be 16280 pounds, and half of this, or 8140 pounds, will be the reaction at each end.

On referring to the Table of Bearing Plates, on page 47, the proper size for this load on the class of masonry in question is found to be 6″ x 10″. The width of flange of a 10-inch 25 lb. standard beam is 4.66 inches.

Substituting these values in the formula for thickness gives

$$t = .00685\,(10 - 4.66)\sqrt{\frac{8140}{6 \times 10}} = .426$$

The nearest commercial size above this is $\frac{7}{16}$ inch, which is the thickness required.

If a shorter plate would suit the location better it may be seen from the table that a plate 8″ x 8″ will give the necessary bearing value and the thickness of this would be

$$t = .00685\,(8 - 4.66)\sqrt{\frac{8140}{8 \times 8}} = .258$$

*and the nearest commercial* size above this is $\frac{5}{16}$″, which is the thickness required.

## BEARING PLATES FOR I-BEAMS AND CHANNELS.

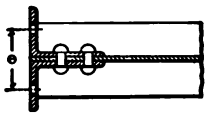
**To be used on walls of different kinds of masonry.**

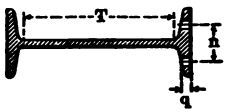
| Bearing on Wall. Inches. | Size of Plate. Inches. | Safe Bearing Value of Plate in Pounds. | | | | Bearing on Wall. Inches. | Size of Plate. Inches. | Safe Bearing Value of Plate in Pounds. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ordinary Stone Masonry. | Good Stone Masonry. | Brick in Lime Mortar. | Brick in Cement Mortar. | | | Ordinary Stone Masonry. | Good Stone Masonry. | Brick in Lime Mortar. | Brick in Cement Mortar. |
| 4 | 4x 4 | 2880 | 4800 | 2400 | 3200 | 14 | 14x14 | 35280 | 58800 | 29400 | 39200 |
| 4 | 4x 6 | 4320 | 7200 | 3600 | 4800 | 14 | 14x16 | 40320 | 67200 | 33600 | 44800 |
| 4 | 4x 8 | 5760 | 9600 | 4800 | 6400 | 14 | 14x18 | 45360 | 75600 | 37800 | 50400 |
| | | | | | | 14 | 14x20 | 50400 | 84000 | 42000 | 56000 |
| 6 | 6x 6 | 6480 | 10800 | 5400 | 7200 | | | | | | |
| 6 | 6x 8 | 8640 | 14400 | 7200 | 9600 | 16 | 16x16 | 46080 | 76800 | 38400 | 51200 |
| 6 | 6x10 | 10800 | 18000 | 9000 | 12000 | 16 | 16x18 | 51840 | 86400 | 43200 | 57600 |
| | | | | | | 16 | 16x20 | 57600 | 96000 | 48000 | 64000 |
| 8 | 8x 8 | 11520 | 19200 | 9600 | 12800 | 16 | 16x22 | 63360 | 105600 | 52800 | 70400 |
| 8 | 8x10 | 14400 | 24000 | 12000 | 16000 | | | | | | |
| 8 | 8x12 | 17280 | 28800 | 14400 | 19200 | 18 | 18x18 | 58320 | 97200 | 48600 | 64800 |
| | | | | | | 18 | 18x20 | 64800 | 108000 | 54000 | 72000 |
| 10 | 10x10 | 18000 | 30000 | 15000 | 20000 | 18 | 18x22 | 71280 | 118800 | 59400 | 79200 |
| 10 | 10x12 | 21600 | 36000 | 18000 | 24000 | 18 | 18x24 | 77760 | 129600 | 64800 | 86400 |
| 10 | 10x14 | 25200 | 42000 | 21000 | 28000 | | | | | | |
| | | | | | | 20 | 20x20 | 72000 | 120000 | 60000 | 80000 |
| 12 | 12x12 | 25920 | 43200 | 21600 | 28800 | 20 | 20x22 | 79200 | 132000 | 66000 | 88000 |
| 12 | 12x14 | 30240 | 50400 | 25200 | 33600 | 20 | 20x24 | 86400 | 144000 | 72000 | 96000 |
| 12 | 12x16 | 34560 | 57600 | 28800 | 38400 | 20 | 20x26 | 93600 | 156000 | 78000 | 104000 |
| 12 | 12x18 | 38880 | 64800 | 32400 | 43200 | | | | | | |

**Bearing values are based on the following allowed pressures ;**

| Masonry. | Allowable Pressure. | |
|---|---|---|
| | Pounds per Square Inch. | Tons per Square Foot. |
| Ordinary Stone | 180 | 12.96 |
| Good Stone | 300 | 21.60 |
| Brick in Lime Mortar | 150 | 10.80 |
| Brick in *Cement Mortar* | 200 | 14.40 |

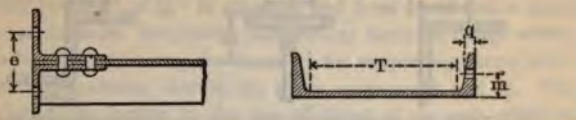
## STANDARD SPACING OF RIVET AND BOLT HOLES THROUGH FLANGES AND CONNECTION ANGLES OF I-BEAMS, AND TANGENT DISTANCES BETWEEN FILLETS MEASURED ALONG THE WEB.




| Depth of Beam. | Weight. | n | e | q | T | Depth of Beam. | Weight. | n | e | q | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches. | Lbs. per Ft. | Inches. | Inches. | In. | Inches. | Inches. | Lbs. per Ft. | Ins. | Inches. | Inches. | Inches. |
| 3 | 5.5 | 1 7/8 | 4 21/32 | 1/4 | 1 13/16 | 12 | 55.0 | 3 | 5 5/16 | 11/16 | 9 5/16 |
| " | 6.5 | " | 4 1/2 | " | " | | | | | | |
| " | 7.5 | " | 4 7/16 | " | " | 15 | 42.0 | 3 | 4 29/32 | 5/16 | 12 1/2 |
| | | | | | | " | 45.0 | " | 4 31/32 | " | " |
| 4 | 7.5 | 1 1/2 | 4 15/16 | 9/32 | 2 11/16 | " | 50.0 | " | 5 1/16 | " | " |
| " | 8.5 | " | 4 3/4 | " | " | " | 55.0 | " | 5 1/8 | " | " |
| " | 9.5 | " | 4 27/32 | 5/16 | " | " | 60.0 | " | 5 1/4 | 21/32 | " |
| " | 10.5 | " | 4 23/32 | " | " | | | | | | |
| 5 | 9.75 | 1 3/4 | 4 23/32 | 5/16 | 3 5/8 | 15 | 60.0 | 3 1/4 | 5 3/16 | 13/16 | 11 3/4 |
| " | 12.25 | " | 4 7/8 | " | " | " | 65.0 | " | 5 1/8 | " | " |
| " | 14.75 | " | 5 | 11/32 | " | " | 70.0 | " | 5 5/32 | 27/32 | " |
| | | | | | | " | 75.0 | " | 5 1/32 | " | " |
| 6 | 12.25 | 2 | 4 29/32 | 11/32 | 4 7/16 | " | 80.0 | " | 4 31/32 | " | " |
| " | 14.75 | " | 4 27/32 | " | " | | | | | | |
| " | 17.25 | " | 4 23/32 | 3/8 | " | 15 | 80.0 | 3 3/4 | 5 5/16 | 1 1/32 | 10 13/16 |
| | | | | | | " | 85.0 | " | 5 1/8 | " | " |
| 7 | 15.00 | 2 1/4 | 4 3/4 | 3/8 | 5 3/8 | " | 90.0 | " | 5 1/32 | " | " |
| " | 17.50 | " | 4 27/32 | " | " | " | 95.0 | " | 4 31/32 | " | " |
| " | 20.00 | " | 4 23/32 | " | " | " | 100.0 | " | 4 15/16 | 1 7/16 | " |
| 8 | 18.00 | 2 1/4 | 4 25/32 | 13/32 | 6 5/16 | | | | | | |
| " | 20.25 | " | 4 23/32 | " | " | 18 | 55.0 | 3 1/4 | 4 31/32 | 11/16 | 15 5/16 |
| " | 22.75 | " | 4 11/16 | 7/16 | " | " | 60.0 | " | 5 1/16 | " | " |
| " | 25.25 | " | 5 1/32 | " | " | " | 65.0 | " | 5 1/8 | 23/32 | " |
| | | | | | | " | 70.0 | " | 5 3/32 | " | " |
| 9 | 21.0 | 2 1/2 | 4 29/32 | 7/16 | 7 1/16 | | | | | | |
| " | 25.0 | " | 4 23/32 | " | " | 20 | 65.0 | 3 1/2 | 5 | 25/32 | 16 13/16 |
| " | 30.0 | " | 5 1/16 | 15/32 | " | " | 70.0 | " | 5 3/32 | " | " |
| " | 35.0 | " | 5 3/32 | " | " | " | 75.0 | " | 5 1/32 | " | " |
| 10 | 25.0 | 2 5/8 | 4 13/16 | 15/32 | 7 15/16 | 20 | 80.0 | 4 | 5 3/32 | 13/16 | 16 7/16 |
| " | 30.0 | " | 4 11/16 | 1/2 | " | " | 85.0 | " | 5 1/32 | " | " |
| " | 35.0 | " | 5 3/32 | 17/32 | " | " | 90.0 | " | 4 15/16 | " | " |
| " | 40.0 | " | 5 1/4 | 17/32 | " | " | 95.0 | " | 5 1/8 | " | " |
| | | | | | | " | 100.0 | " | 5 1/8 | 13/16 | " |
| 12 | 31.5 | 2 3/4 | 4 27/32 | 17/32 | 9 3/4 | | | | | | |
| " | 35.0 | " | 4 11/16 | " | " | | | | | | |
| " | 40.0 | " | 5 1/16 | 9/16 | " | 24 | 80.0 | 4 | 5 | 27/32 | 20 11/16 |
| | | | | | | " | 85.0 | " | 5 1/16 | " | " |
| *12* | *40.0* | *3* | 4 31/32 | 31/32 | 9 5/16 | " | 90.0 | " | 5 1/8 | 7/8 | " |
| " | *45.0* | " | 5 3/32 | " | " | " | 95.0 | " | 5 3/16 | " | " |
| " | *50.0* | " | 5 1/16 | " | " | " | 100.0 | " | 5 1/4 | " | " |

# STANDARD SPACING OF RIVET AND BOLT HOLES IN FLANGES AND CONNECTION ANGLES OF CHANNELS, AND TANGENT DISTANCES BETWEEN FILLETS MEASURED ALONG THE WEB.

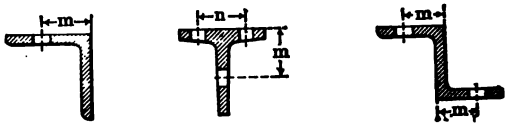



| Depth of Channel | Weight. | m | e | q | T | Depth of Channel | Weight. | m | e | q | T |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches. | Lbs. per Ft. | Inches. | Inches. | In. | Inches. | Inches. | Lbs. per Ft. | Inches. | Inches. | In. | Inches. |
| 3 | 4.0 | 15/16 | 4 31/32 | 1/4 | 1 13/16 | 8 | 21.25 | 1 9/16 | 5 3/32 | 13/32 | 6 1/16 |
| " | 5.0 | " | 4 7/8 | " | " | 9 | 13.25 | 1 5/8 | 4 3/4 | 13/32 | 7 1/4 |
| " | 6.0 | " | 4 7/8 | 9/32 | " | " | 15.00 | 1 7/16 | 4 13/16 | " | " |
| 4 | 5.25 | 1 | 4 11/16 | 5/16 | 2 1/16 | " | 20.00 | 1 9/16 | 4 13/16 | 3/8 | " |
| " | 6.25 | " | 4 3/4 | " | " | " | 25.00 | 1 3/4 | 5 1/8 | 15/32 | " |
| " | 7.25 | " | 4 17/32 | 5/16 | " | | | | | | |
| 5 | 6.5 | 1 | 4 11/16 | 5/16 | 3 5/8 | 10 | 15.0 | 1 1/2 | 4 3/4 | 7/16 | 8 3/16 |
| " | 9.0 | 1 1/4 | 4 17/32 | 9/32 | " | " | 20.0 | 1 5/8 | 4 13/16 | " | " |
| " | 11.5 | " | 4 31/32 | 5/16 | " | " | 25.0 | 1 3/4 | 5 1/32 | 3/8 | " |
| 6 | 8.0 | 1 1/16 | 4 11/16 | 11/32 | 4 1/2 | " | 30.0 | 1 13/16 | 5 1/16 | 13/32 | " |
| " | 10.5 | 1 1/16 | 4 13/16 | " | " | " | 35.0 | 2 1/16 | 5 1/16 | 7/16 | " |
| " | 13.0 | 1 1/16 | 4 15/16 | " | " | 11 | 20.5 | 1 3/4 | 4 31/32 | 15/32 | 9 13/16 |
| " | 15.5 | 1 1/16 | 5 1/16 | " | " | " | 25.0 | 1 5/8 | 4 7/8 | 1/2 | " |
| 7 | 9.75 | 1 3/16 | 4 23/32 | 11/32 | 5 7/16 | " | 30.0 | 2 | 5 | 17/32 | " |
| " | 12.25 | 1 1/16 | 4 15/16 | 3/8 | " | " | 35.0 | 2 1/8 | 5 1/8 | 17/32 | " |
| " | 14.75 | 1 1/16 | 4 23/32 | " | " | " | 40.0 | 2 1/4 | 5 1/4 | 17/32 | " |
| " | 17.25 | 1 1/2 | 5 1/16 | " | " | 15 | 33.0 | 1 7/8 | 4 23/32 | 21/32 | 12 3/8 |
| " | 19.75 | 1 5/8 | 5 1/16 | " | " | " | 35.0 | 1 13/16 | 4 15/16 | " | " |
| 8 | 11.25 | 1 1/4 | 4 23/32 | 3/8 | 6 5/16 | " | 40.0 | 2 | 5 1/32 | 11/16 | " |
| " | 13.75 | 1 1/16 | 4 13/16 | 13/32 | " | " | 45.0 | 2 1/8 | 5 1/8 | 5/8 | " |
| " | 16.25 | 1 3/8 | 4 23/32 | 3/8 | " | " | 50.0 | 2 1/4 | 5 3/16 | 21/32 | " |
| " | 18.75 | 1 1/2 | 5 | 13/32 | " | " | 55.0 | 2 5/16 | 5 5/16 | " | " |

# MAXIMUM SIZE OF RIVETS IN BEAMS AND CHANNELS.

| I-Beams. | | | | | | Channels. | | |
|---|---|---|---|---|---|---|---|---|
| Depth of Beam. | Weight. | Diameter of Rivets. | Depth of Beam. | Weight. | Diameter of Rivets. | Depth of Channel. | Weight. | Diameter of Rivets. |
| Inches. | Lbs. per Ft. | Inches. | Inches. | Lbs. per Ft. | Inches. | Inches. | Lbs. per Ft. | Inches. |
| 3 | 5.50 | 3/8 | 15 | 42.0 | 3/4 | 3 | 4.00 | 3/8 |
| 4 | 7 50 | 1/2 | 15 | 60.0 | " | 4 | 5.25 | 1/2 |
| 5 | 9.75 | " | 15 | 80.0 | 7/8 | 5 | 6.50 | " |
| 6 | 12.25 | 5/8 | 18 | 55.0 | " | 6 | 8.00 | 5/8 |
| 7 | 15.00 | " | 20 | 65.0 | 1 | 7 | 9.75 | " |
| 8 | 18.00 | 3/4 | 20 | 80.0 | " | 8 | 11.25 | 3/4 |
| 9 | 21.00 | " | 24 | 80.0 | " | 9 | 13.25 | " |
| 10 | 25.00 | " | | | | 10 | 15.00 | " |
| 12 | 31.50 | " | | | | 12 | 20.50 | " |
| 12 | 40.00 | " | | | | 15 | 33.00 | " |

# STANDARD SPACING OF RIVET AND BOLT HOLES IN ANGLES, T-BARS AND Z-BARS, WITH MAXIMUM SIZE OF RIVETS TO BE USED.




## ANGLES.

| Length of Leg. Inches. | m Inches. | Diameter of Rivet. Inches. | Length of Leg. Inches. | m Inches. | Diameter of Rivet. Inches. | Length of Leg. Inches. | m Inches. | Diameter of Rivet. Inches. |
|---|---|---|---|---|---|---|---|---|
| ¾ | 7/16 | ¼ | 2 | 1 1/16 | 5/8 | 3½ | Variable, depending on diameter of rivet, thickness of metal and length of leg. | 1 |
| 1 | 1/2 | 5/16 | 2¼ | 1 1/4 | 3/4 | 4 | | " |
| 1¼ | 11/16 | 3/8 | 2½ | " | 7/8 | 4½ | | " |
| 1½ | 13/16 | 7/16 | 2⅝ | 1 3/8 | " | 5 | | " |
| 1⅝ | 7/8 | " | 2¾ | 1 1/2 | " | 6 | | " |
| 1¾ | 15/16 | " | 3 | 1¾ | 7/8 | 7 | | " |
| 1⅞ | 1 | 5/8 | | | | | | |

## T-BARS.

| Section Number. | Width of Flange. Inches. | Depth of Bar. Inches. | Weight. Lbs. per Ft. | m Inches. | Max. Diam. of Rivets in Stem. Inches. | n Inches. | Max. Diam. of Rivets in Flange. Inches. |
|---|---|---|---|---|---|---|---|
| T 97 | 3½ | 3½ | 9.3 | 2 | 1 | 1¾ | 5/8 |
| " 69 | 3 | 3 | 7.8 | 1¾ | 7/8 | 1 5/8 | 1/2 |
| " 67 | 3 | 3 | 6.6 | " | " | 1½ | " |
| " 49 | 2½ | 2½ | 5.5 | 1⅜ | 3/4 | 1 3/8 | " |
| " 42 | 2½ | 2¼ | 4.9 | 1 1/8 | " | 1 1/8 | " |
| " 41 | " | " | 4.1 | " | " | " | " |
| " 39 | 2 | 2 | 4.3 | 1 1/8 | 5/8 | 1 | " |
| " 37 | " | " | 3.7 | " | " | " | " |
| "189 | 1⅜ | 1⅜ | 1.85 | ¾ | ½ | 5/8 | ¼ |
| "187 | 1 1/2 | 1 1/2 | 1.61 | 11/16 | " | " | " |
| "183 | 1⅜ | 1⅜ | 1.53 | 5/8 | " | " | " |
| "181 | 1 1/8 | 1 1/8 | 1.39 | 9/16 | " | " | " |
| " 5 | 1 | 1 | 0.89 | " | 3/8 | " | " |
| "101 | 3½ | 4 | 9.9 | 2¼ | 1 | 1¾ | 5/8 |
| "169 | 5 | 3 | 13.6 | 1¾ | 7/8 | 2⅜ | 3/4 |
| " 65 | 3 | 2½ | 7.2 | 1⅜ | 3/4 | 1 1/2 | 1/2 |
| " 22 | 2½ | 1½ | 2.9 | 11/16 | 1/2 | 1 1/4 | 1/2 |
| "185 | 1¼ | 1 1/16 | 1.49 | 9/16 | 5/16 | 5/8 | 1/4 |

## Z-BARS.

| Section Number. | Depth of Bar. Inches. | Weight. Lbs. per Foot. | m Inches. | Max. Diam. of Rivets. Inches. |
|---|---|---|---|---|
| Z 5-Z 9-Z13 | 3 to 3½ | 6.7 to 14.2 | 1⅝ | ⅝ |
| "21-"25-"29 | 4 " 4½ | 8.2 " 23.0 | 1¾ | ¾ |
| "37-"41-"45 | 5 " 5½ | 11.6 " 28.3 | 1 7/8 | ⅞ |
| "53-"57-"61 | 6 " 6½ | 15.6 " 34.6 | 2 | 1 |

## 'IREPROOF FLOORS AND MATERIAL.

›of floors in buildings are composed of steel I-Beams spaced e distances, supported laterally by means of tie rods, which ly from ⅝″ to ⅞″ in diameter and from 4 to 6 feet or more at distances not greater than twenty times the flange width. for this, explaining the necessity for supporting beams later- ı table relating thereto, are given on pages 64 and 65. The hould be located in the line of thrust of the arch, which is r below the centre line of the beam, and in some cases is near n flange.

:n the beams are laid fireproof arches, usually of hollow tile, ould be so constructed as to wholly enclose the steel and o a sufficient thickness to insure the fireproof character of the ion.

## THRUST OF ARCHES.

›rizontal thrust of segmental floor arches, on the assumption n loading, may be found by the following formula:

$$T = \frac{3WL^2}{2R}$$

ısure or thrust in pounds per lineal foot of arch.

l on arch in pounds per square foot, uniformly distributed.

n of arch in feet.

of segmental arch in inches.

concentrated load at the centre, of weight P, the thrust

$$T = \frac{3PL}{R}$$

:hes with flat tops and bottoms, such as are used in floors, the oints on each side of the central key are usually laid out on ines, and in these cases the thrust may be determined approx- y using for R in the above formula the effective depth of the

gmental arches the *rise* R is the vertical distance from the *art of the intrados to the* plane of the springing line. If the

radius of the intrados for segmental arches is r, the rise may be obtained from the following formula:

$$R = r - \sqrt{r^2 - \frac{L^2}{4}}$$

$$\text{conversely, } r = \frac{R}{2} + \frac{L^2}{8R}$$

## TIE RODS.

Although in the completed structure the horizontal thrusts of adjoining arches may counterbalance each other, the tie rods should be so proportioned and spaced as to withstand the entire thrust of the arches, thus tying the structure together and facilitating the construction.

## BEAM TABLES.

Tables of safe loads for beams and channels and spacings of I-Beams for floors are given with explanatory notes on pages 72 to 137.

## BEAMS AS GIRDERS.

In some cases two or more beams may be bolted together side by side to form a girder, in which case cast iron separators with bolts should be used to hold the various members together. Separators should be placed at each end of the girder, at points of concentrated loading, and for uniform loading should be located at distances apart not greater than twenty times the width of the smallest beam flange, in order to laterally support the upper flanges which are in compression and prevent their failure by buckling. The separators should fit closely between the beam flanges so as to unite the beams forming the girder and thereby cause them to act together in resisting the load. A table of separators is given on page 42.

## CONNECTION ANGLES.

When beams are coped or fitted together at right angles, connection angles are generally used, standards for which, covering usual cases, are shown on pages 43, 44 and 45. Explanations and tables of limiting spans for which these standards may be used are given on pages 40 and 41. Beams may be fitted together thus with flush tops or bottoms or in intermediate positions, as required in cases where the girder or trimmer beam is the larger. In cases where the girder or trimmer beam *is the smaller, special* stirrups or other connections are required.

## LIVE LOADS FOR FLOORS.

The following loads per square foot, exclusive of weight of floor materials, show the range assumed in usual practice:

Dwellings..... 70 lbs. per sq. ft.
Offices..... 70 to 100 lbs. per sq. ft.
Buildings for public assembly..120 to 150 lbs. per sq. ft.
Stores, warehouses, etc.....150 to 250 lbs. and upwards per sq. ft.

On page 267 are given in detail the safe loads for which floors should be designed in accordance with the building laws of various cities.

## FLOOR ARCHES.

Hollow tile floor arches and fireproofing material used in connection with the structural steel work of buildings are now made of various classes, the principal ones being known as "hard clay" and "porous terra-cotta," both of which are moulded and burned in a manner similar to that used in making bricks. Various new forms of floor arches, composed of cement concrete with or without skeletons of wire, wire cloth, T-Bars, I-Beams, and metal rods of various shapes and arrangements, have also been brought out in recent years.

Hard clay floor arches and fireproof materials weigh somewhat more than the porous terra-cotta materials of similar sizes.

## POROUS TERRA-COTTA.

Porous terra-cotta, which is now largely used for fireproof floor arches, beam, girder, and column protection, roof and ceiling tile, etc., is a mixture of clay and sawdust, or other equivalent combustible matter. After the compound is properly mixed, the brick or tiles are moulded, and when sufficiently dry are placed in a kiln prepared for the purpose and subjected to an intense heat, adequate to consume all the combustible material, leaving the brick porous, and at the same time reducing the weight materially, the fireproof qualities remaining intact. This material admits driving of nails and receives and holds plaster.

## END CONSTRUCTION.

The end construction floor arches, in which the hollow spaces are at right angles to the beams, are stronger and lighter than the old style construction, in which the openings are parallel with the beams.

Approximate weights of hollow tile floor arches and fireproof materials are *given in the following* table:

# WEIGHTS OF HOLLOW TILE FLOOR ARCHES AND FIREPROOF MATERIALS.

## END CONSTRUCTION, FLAT ARCH.

| Width of Span Between Beams. | Depth of Arch. | Weight per Square Foot. |
|---|---|---|
| 5 feet to 6 feet. | 8 inches. | 27 pounds. |
| 6 " 7 " | 9 " | 29 " |
| 7 " 8 " | 10 " | 33 " |
| 8 " 9 " | 12 " | 38 " |

## HOLLOW BRICK FOR FLAT ARCHES

(SIDE CONSTRUCTION).

| Width of Span Between Beams. | Depth of Arch. | Weight per Square Foot. |
|---|---|---|
| 3 feet 6 inches to 4 feet 0 inches. | 6 inches. | 27 pounds. |
| 4 " 0 " 4 " 6 " | 7 " | 29 " |
| 4 " 6 " 5 " 0 " | 8 " | 32 " |
| 5 " 6 " 6 " 0 " | 9 " | 36 " |
| 6 " 0 " 6 " 6 " | 10 " | 39 " |
| 6 " 6 " 7 " 0 " | 12 " | 44 " |

## PARTITIONS.

| | Thickness. | Weight per Square Foot. |
|---|---|---|
| Hollow Brick (Clay) Partitions | 2 inches. | 11 pounds. |
| " " " " | 3 " | 14 " |
| " " " " | 4 " | 15 " |
| " " " " | 5 " | 19 " |
| " " " " | 6 " | 20 " |
| " " " " | 8 " | 27 " |
| Porous Terra-Cotta Partitions | 3 " | 16 " |
| " " " " | 4 " | 19 " |
| " " " " | 5 " | 22 " |
| " " " " | 6 " | 23 " |
| " " " " | 8 " | 33 " |

## FURRING, ROOFING AND CEILING.

| | Thickness. | Weight per Square Foot. |
|---|---|---|
| Porous Terra-Cotta Furring | 2 inches. | 8 pounds. |
| " " " Roofing | 2 " | 12 " |
| " " " " | 3 " | 15 " |
| " " " " | 4 " | 19 " |
| " " " Ceiling | 2 " | 11 " |
| " " " " | 3 " | 15 " |
| " " " " | 4 " | 19 " |

6-inch Segmental Arches, 27 pounds per square foot.
8- " " " 33 " " " "
*2-inch Porous* Terra-Cotta Partition, 8 pounds per square foot.

## TESTS OF FLOOR ARCHES.

Reports of tests of various forms of floor arches may be found in the *American Architect*, March, 1891.

One of the most recent and complete papers on this subject is entitled "Tests of Fire-proof Flooring Material," published in the *Transactions of the American Society of Civil Engineers*, with discussions, in Vols. xxxiv and xxxv, dated 1895 and 1896.

A summary of the principal data and results of the tests which were the subject of the latter paper is given in the following table:

### BREAKING LOAD OF HOLLOW TILE ARCHES.

| Depth of Arch. | Rise. | Span. | Length. | Total Load. | Load per Sq. Foot. | Total Horizontal Thrust. | Horizontal Thrust per Ft. of Arch. | BLOCKS. | | Character of Load. | Manner of Laying Joints. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Style. | Material. | | |
| Ins. | Ins. | Ins. | Ins. | Lbs. | Lbs. | Lbs. | | | | | |
| 6. | 3.5 | 60 | 48. | 13750 | 688 | 29474 | 7369 | E | Hard | Dis. | Port. |
| 7.5 | 5. | 46 | 11.5 | 9000 | 2452 | 10367 | 10818 | " | " | " | N. M. |
| 7.5 | 5. | 60 | 35.2 | 11250 | | 33750 | 11505 | " | " | Cen. | Port. |
| 7.5 | 5. | 60 | 36.5 | 13000 | | 39000 | 12822 | " | Porous | " | " |
| 8. | 7. | 60 | 38.25 | 14500 | | 31071 | 9747 | " | " | " | " |
| 8. | 7. | 60 | 38.25 | 15750 | | 33750 | 10588 | " | Hard | " | " |
| 12. | 10. | 60 | 41. | 16400 | | 24600 | 7200 | " | " | " | " |
| 12. | 8.75 | 60 | 10. | 3100 | | 5314 | 6377 | " | " | " | N. M. |
| 12. | 9. | 60 | 10. | 5000 | | 8333 | 10000 | " | " | " | " |
| 12. | 9. | 60 | 10. | 15100 | 3630 | 12583 | 15100 | " | " | Dis. | " |
| 12. | 9.5 | 60 | 10. | 2500 | | 3947 | 4736 | " | " | Cen. | ..... |
| 8. | 5.5 | 46 | 11.5 | 2500 | 681 | 2614 | 2727 | S | " | Dis. | N. M. |
| 8. | 5. | 45 | 11.5 | 1300 | 362 | 1463 | 1526 | " | " | " | " |
| 8. | 6. | 60 | 36. | 10000 | | 25000 | 8333 | " | " | Cen. | Port. |
| 8. | 5. | 60 | 36. | 5700 | 380 | 8550 | 2850 | " | " | Dis. | " |
| 8. | 5. | 60 | 12. | 3500 | 700 | 5250 | 5250 | " | " | " | N. M. |
| 8. | 5.5 | 60 | 12. | 10000 | 2000 | 13636 | 13636 | " | " | " | " |
| 8. | 5.5 | 60 | 12. | 2500 | | 6818 | 6818 | " | " | Cen. | " |
| 8. | 5.5 | 60 | 24. | 9950 | 995 | 13568 | 6784 | " | " | Dis. | " |
| 8. | 5.5 | 60 | 24. | 2500 | | 6818 | 3209 | " | " | Cen. | " |
| 10. | 7.5 | 60 | 36. | 13500 | 900 | 13500 | 4500 | " | " | Dis. | Port. |
| 10. | 8. | 60 | 37. | 14500 | 940 | 13594 | 4408 | " | " | " | ..... |

NOTE.—In the above table the following abbreviations are used: "E," End Construction; "S," Side Construction; "Hard," Hard Clay; "Porous," Porous Terra-Cotta; "Dis.," Distributed Load; "Cen.," Concentrated Load at Centre; "Port.," Portland Cement, and "N. M.," No Mortar.

The Loads per Sq. Foot in the above table were obtained in all cases by dividing the Total Load by the superficial area of the arch in square feet. The Horizontal Thrust for distributed and Central Loads were obtained by formulæ similar to those given therefor on one of the preceding pages, and for Central Loads this is double that for a distributed load of the same weight.

The conclusions drawn from the above tests by the author of the paper, Mr. George W. Hill, Consulting Engineer, are as follows:

*First.*—That the side construction arch requires a skew in which the inclined member on the line of the arch thrust runs back to a solid support against either the fillet or the flange of the skewback beam.

*Second.*—The end-construction arch requires good mortar and reasonably good bedding to make the joints which transmit the pressure adequate to their duty, the weak point being the mortar in the end joints.

*Third.*—When well bedded, the end-construction arch is very much the stronger.

## SAFE LOADS FOR FLOOR ARCHES.

Two tables of safe loads for hollow tile arches have been prepared, based on an average of the results of the tests given on the preceding page, using a safety factor of six.

The first of these tables gives the gross safe loads of various sized arches for different spans, including the weight of the hollow tiles, and the second gives the safe load superimposed or net loads for similar conditions, exclusive of the weights of the arches.

The former table may be used for flat arches of any weight by deducting the weight of the arch per square foot from the tabular safe load, which will give the safe net or superimposed load per square foot, while the latter table gives at once the safe superimposed load for arches of weights specified, corresponding to the tabulated weights of arches given on page 54.

These tables refer to flat hollow tile arches, the bottoms of which project below the beams in order to provide for fire protection of their lower flanges.

This projection varies from $1\frac{3}{4}''$ to $3''$ for different sizes and makes of hollow tiles, the average for the sizes given being 2.4 inches, which is assumed to be the amount by which the nominal depth is decreased in order to obtain the effective depth or rise for calculation of the *thrust by means of the* formula therefor given on page 51.

The formula for safe load used in computing the tables below is as ollows:

$$W=840\,\frac{R}{L^2}$$

n which

W=safe load per square foot of arch in pounds.

R=rise or effective depth of arch in inches.

L=span of arch in feet.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR HOLLOW TILE FLOOR ARCHES.

Gross loads in pounds per square foot, *i. e.*, including the weight of he arch. Safety Factor 6.

| Nominal Depth. | Effective Depth. R | Span of Arch in Feet — L | | | | | |
|---|---|---|---|---|---|---|---|
| Inches. | Inches. | 3 | 4 | 5 | 6 | 7 | 8 |
| 6 | 3.6 | 336 | 189 | 121 | | | |
| 7 | 4.6 | 429 | 242 | 155 | | | |
| 8 | 5.6 | 523 | 294 | 188 | 131 | | |
| 9 | 6.6 | 616 | 347 | 222 | 154 | 113 | |
| 10 | 7.6 | 709 | 399 | 255 | 177 | 130 | 100 |
| 12 | 9.6 | 896 | 504 | 323 | 224 | 165 | 126 |

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR HOLLOW TILE FLOOR ARCHES.

Net loads in pounds per square foot, *i. e.*, excluding the weight of ıe arch. Safety Factor 6.

| Nominal Depth. | Effective Depth. R | Weight of Arch per Square Foot. | Span of Arch in Feet — L. | | | | | |
|---|---|---|---|---|---|---|---|---|
| Inches. | Inches. | Pounds. | 3 | 4 | 5 | 6 | 7 | 8 |
| 6 | 3.6 | 27 | 309 | 162 | 94 | | | |
| 7 | 4.6 | 29 | 400 | 213 | 126 | | | |
| 8 | 5.6 | 32 | 481 | 262 | 156 | 99 | | |
| 9 | 6.6 | 36 | 580 | 311 | 186 | 118 | 77 | |
| 10 | 7.6 | 39 | 670 | 360 | 216 | 136 | 91 | 61 |
| 12 | 9.6 | 44 | 852 | 460 | 279 | 180 | 121 | 82 |

## SPACING OF TIE RODS FOR TILE ARCHES.

The table on the next page was computed from the following formula, which was obtained from that giving the thrust of arches on page 51.

$$B = \frac{A \times R \times 10\,000}{WL^2}$$

in which

B = spacing of tie rods in feet.
A = net area of rod in square inches.
R = rise of arch in inches.
W = load in pounds per square foot of the arch.
L = span of arch in feet.

The above formula gives the spacing of tie rods corresponding to a tensile stress in the rods of 15 000 pounds per square inch, without considering the flexure of the beams.

In spacing tie rods, the lateral strength of beams, for flexure due to the thrust of the arches should be taken into consideration, explanations for which are given on pages 60 to 63 herein.

Spacings for other loads than that of the table may be found by proportion, thus:

Required spacing =

$$\frac{100 + \text{weight of arch in pounds per square foot}}{\text{New load in lbs. per sq. ft.} + \text{weight of arch in lbs. per sq. ft.}} \times \text{spacing from table.}$$

Weights of tile arches per square foot are given on page 54.

As noted under the heading "Lateral Strength of Beams," on pages 64 and 65, care should be taken that the spacing of tie rods is not greater than twenty times the least flange width, otherwise the safe loads should be reduced to compensate for the strains produced by flexure of the upper flange considered as a column in compression.

## SPACING OF TIE RODS FOR TILE ARCHES.

For a uniform load of 100 lbs. per square foot in addition to the weight of the arch.

| Span of Arch. Feet. | Diameter of Tie Rods. Inches. | Nominal Depth of Arch. Inches. | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | 7 | 8 | 9 | 10 | 12 |
| | | Effective Depth or Rise of Arch. Inches. | | | | | |
| | | 3.6 | 4.6 | 5.6 | 6.6 | 7.6 | 9.6 |
| 3 | $\frac{5}{16}$ | 6.4 | 8.0 | 9.5 | 10.9 | 12.3 | 15.0 |
| " | $\frac{7}{16}$ | 9.5 | 12.0 | 14.2 | 16.3 | 18.3 | 22.4 |
| " | $\frac{1}{2}$ | 13.2 | 16.6 | 19.8 | 22.6 | 25.5 | 31.1 |
| 4 | $\frac{5}{16}$ | 3.6 | 4.5 | 5.4 | 6.1 | 6.9 | 8.4 |
| " | $\frac{7}{16}$ | 5.4 | 6.7 | 8.0 | 9.2 | 10.3 | 12.6 |
| " | $\frac{1}{2}$ | 7.4 | 9.4 | 11.1 | 12.7 | 14.3 | 17.5 |
| 5 | $\frac{5}{16}$ | 2.3 | 2.9 | 3.4 | 3.9 | 4.4 | 5.4 |
| " | $\frac{7}{16}$ | 3.4 | 4.3 | 5.1 | 5.9 | 6.6 | 8.0 |
| " | $\frac{1}{2}$ | 4.8 | 6.0 | 7.1 | 8.1 | 9.2 | 11.2 |
| 6 | $\frac{5}{16}$ | .. | 2.0 | 2.4 | 2.7 | 3.1 | 3.7 |
| " | $\frac{7}{16}$ | .. | 3.0 | 3.6 | 4.1 | 4.6 | 5.6 |
| " | $\frac{1}{2}$ | .. | 4.2 | 4.9 | 5.7 | 6.4 | 7.8 |
| 7 | $\frac{5}{16}$ | .. | .. | .. | 2.0 | 2.3 | 2.8 |
| " | $\frac{7}{16}$ | .. | .. | .. | 3.0 | 3.4 | 4.1 |
| " | $\frac{1}{2}$ | .. | .. | .. | 4.2 | 4.7 | 5.7 |
| 8 | $\frac{5}{16}$ | .. | .. | .. | .. | 1.7 | 2.1 |
| " | $\frac{7}{16}$ | .. | .. | .. | .. | 2.6 | 3.1 |
| " | $\frac{1}{2}$ | .. | .. | .. | .. | 3.6 | 4.4 |

## LATERAL STRENGTH OF BEAMS TO RESIST FLEXURE DUE TO THRUST OF ARCHES, ETC.

In special cases where the thrust of a floor arch is exerted against a beam, channel, angle or other shape without other lateral support than the tie rods, or braces, this will produce lateral flexure and stresses in addition to those caused by the vertical loading. Throughout the body of the floor the thrusts of the adjoining arches when completed will usually counterbalance each other, but in the outer beams around shafts or elsewhere if unsupported sideways the stresses due to the lateral forces should be considered.

The total allowable stress per square inch for the extreme fibres of beams has been placed at 16 000 pounds per square inch, and in order that this may not be exceeded owing to lateral stresses, the stress due to vertical loading should be correspondingly reduced so that the resultant intensity shall not exceed the allowable limit. This may be calculated by considering the beam as continuous and laterally supported at intervals by the tie rods, the spans being equal to the spacing of the rods.

In this case the fibre stress due to the lateral forces is:

$$p' = \frac{w x_1 B^2}{I'} \qquad (1)$$

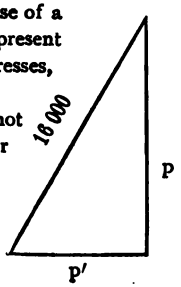
in which

$p'$ = fibre stress in pounds per square inch due to lateral forces.
$w$ = lateral load or thrust in pounds per lineal foot of section used as a beam.
$x_1$ = distance of the extreme fibre from the neutral axis in inches.
$B$ = distance between tie rods or lateral supports in feet.
$I'$ = moment of inertia about the vertical axis of the section or that one at right angles to the line of application of the lateral forces.

For I-Beams with the web placed vertically as usual $x_1$ becomes equal to $\frac{b}{2}$, where b is the width of the flange in inches. In this case the above formula for intensity of unit stress due to lateral load becomes:

$$p' = \frac{w b B^2}{2 I'} \qquad (2)$$

The resultant fibre stress from the horizontal or lateral and the vertical loads may be represented by the hypothenuse of a right angle triangle, the two sides of which represent the intensities of the horizontal and vertical stresses, thus:




In order that the total resultant stress shall not exceed the allowable limit of 16 000 pounds per square inch, the stress due to vertical loading should therefore be reduced to equal the following:

$$p = \sqrt{16\,000^2 - p'^2} \qquad (8)$$

Having thus obtained the reduced vertical stress p, the safe vertical load of the tables corresponding to this stress should accordingly be reduced by multiplying it by the ratio $\frac{p}{16\,000}$ and similarly for other stresses and corresponding loads, thus making proper allowance for the additional stresses produced by the lateral forces.

If the reduction of the safe loads on this account is a considerable proportion of the original amount due to vertical loading only, it would be more economical to provide lateral braces or tie rods at shorter intervals, thus avoiding the use of an excessive amount of material in the beam.

As the stresses due to vertical forces for usual cases of loading are a maximum at the centre of the span it will ordinarily be sufficient to space the tie rods or braces at shorter intervals near the centre in order to allow for the combined stresses due to vertical loading and horizontal thrusts.

The above method of calculation is not exact when considering the lateral thrust of arches, or loads from similar materials which do not exert a uniform pressure throughout their surfaces of contact with the sustaining beam on account of the friction and bond of their component parts, but this analysis of the stresses may serve as a guide in designing.

The above formulæ should be used in connection with the tables and formula given on pages 64 and 65, relating to the lateral strength of beams, due to compression of the upper flange figured as a column *between points of lateral support.*

EXAMPLE.

What is the proper size of I-Beam without other lateral support than the usual tie rods, corresponding to a total fibre stress of 16 000 pounds per square inch under the following conditions? The beam is 18 feet between end supports and carries a tile arch on one side having a nominal depth of 9 inches, effective depth of 6.6 inches, a span of 5 feet, designed to carry a superimposed load of 100 pounds per square foot in addition to the weight of the arch and other floor materials. The hollow tile arch weighs 36 pounds per square foot and the other materials, including plastering, weigh 14 pounds, making a total load, exclusive of the weight of the beam, equal to 150 pounds per square foot.

For tie rods of ¾″ diameter the spacing between them would be 5.9 feet, as shown by the table of Spacing of Tie Rods on page 59, in which the safe stresses in the rods only are considered.

Substituting the proper values in the formula for lateral thrust of arches, given on page 51, this will be

$$T = \frac{8 \times 150 \times 5^2}{2 \times 6.6} = 852 \text{ lbs. per lineal foot.}$$

Substituting this value for w in formula (2) page 60, we have

$$p' = \frac{852 \times 4.66 \times 5.9^2}{2 \times 6.89} = 10\,029 \text{ lbs. per sq. in.}$$

Therefore $p = \sqrt{16\,000^2 - 10\,029^2} = 12\,466$ lbs. per sq. in.

Hence the safe load as determined by the consideration of vertical loads only, should be reduced to $\frac{12\,466}{16\,000}$, or approximately ¾ of the amount given by the Tables of Safe Loads in case the spacing of the tie rods is not changed.

Assume a 10″ beam 25 lbs. per foot, the moment of inertia of which is 6.89, as given in the Tables of Properties of I-Beams, page 160.

The safe vertical load for a 10″ beam, weighing 25 lbs. per foot, 18 feet long between supports, for fibre stress of 16 000 lbs. per square inch, is 14 470 lbs. uniformly distributed, including the weight of the beam as given in the Tables of Safe Loads, on page 80, or 14 020 exclusive of the weight of the beam, and ¾ of this is 10 515 lbs., which *is the vertical* load it can safely carry in order that the total stress due *to it and the lateral thrust* shall not exceed 16 000 lbs. per square inch.

The actual vertical load on the beam under consideration is as follows:

$$\frac{5}{2} \times 18 \times 150 = 6\,750 \text{ lbs.},$$

which is less than the allowable amount, 10 515 lbs., as figured above, so that a smaller beam may suffice.

Therefore, assume a 9-inch beam, weighing 21 lbs. per foot, the moment of inertia of which about an axis coincident with centre line of web is found in the Table of Properties, on page 160, to be 5.16.

In this case

$$p' = \frac{852 \times 4.33 \times 5.9^2}{2 \times 5.16} = 12\,444 \text{ lbs. per sq. in.}$$

Substituting this in the formula for p we have

$$p = \sqrt{16\,000^2 - 12\,444^2} = 10\,106 \text{ lbs. per sq. in.}$$

Therefore the safe vertical load will be $\frac{10\,106}{16\,000}$, or approximately $\frac{5}{8}$ of the tabular safe load.

The safe vertical load for a 9″ 21 lb. beam, 18 feet long, for a fibre stress of 16 000 lbs. per square inch is 11 180 lbs., as given in the Tables of Safe Loads, on page 80, and $\frac{5}{8}$ of this is 6 987 lbs., which is slightly greater than the actual amount, 6 750 lbs., as calculated above, so that the 9″ 21 lb. beam will suffice.

If the spacing of the tie rods at the centre be reduced from 5.9 feet to 4 feet it may be found in a manner similar to that used in the above calculations, that the safe vertical load for an 8″ I-Beam, weighing 18.0 lbs. per foot, is reduced to $\frac{7}{8}$ of its tabular value of 8 430 lbs., or 7 376 lbs., and as this amount is greater than the actual load as above, namely 6 750 lbs., the 8″ beam would answer the purpose, under the changed conditions as to spacing of tie rods. As this beam might deflect beyond the limit for plastered ceilings, it should be examined in accordance with the rule or formula given for obtaining safe deflections in the explanation of the Tables of Safe Loads, and elsewhere herein.

Calculating this by the rule given on pages 73 and 74, the safe load for the allowable limit of deflection is

$$W = \frac{9\,480 \times 16^2}{18^2} = 7\,491 \text{ lbs.},$$

which is greater than the actual amount, 6 750 lbs., so that the 8″ beam is sufficient and proper if the spacing of central tie rods be changed to 4 feet, as assumed in the last case.

## LATERAL STRENGTH OF BEAMS, WITHOUT LATERAL SUPPORT.

The Tables of Safe Loads for Cambria I-Beams and Channels and Tables of Spacing of Cambria I-Beams, on pages 77 to 137, are calculated on the assumption that proper provision is made for preventing lateral deflection by means of tie rods or other braces. In order to prevent undue strains in the compression flange, considered as a column, the beams should be supported laterally at distances not exceeding twenty times the flange width, this ratio being determined by the following formula, which gives the safe load for solid columns of soft steel:

$$p = \frac{18000}{1 + \frac{l^2}{3000b^2}}$$

in which

p = allowable stress in pounds per square inch.
l = length between lateral supports in inches.
b = width of flange in inches.

Substituting 16 000 for p in the above formula, which is the allowable unit stress of the safe load tables, it is found that the ratio $\frac{l}{b} = 19.37$, from which it may be seen that the compression flange should be supported laterally at distances not exceeding twenty times the flange width as stated above.

Beams which are not thus supported laterally should not be loaded to their full transverse capacity. The allowable fibre stresses and proportions of their full loads which they can safely carry when laterally supported at various distances is given in the following table:

## REDUCTION IN VALUES OF ALLOWABLE FIBRE STRESS AND SAFE LOADS FOR SHAPES USED AS BEAMS DUE TO LATERAL FLEXURE.

| Ratio of Span or Distance between Lateral Supports to Flange Width. | Allowable Unit Stress for Direct Flexure in Extreme Fibre. | Proportion of Tabular Safe Load to be Used. | Ratio of Span or Distance between Lateral Supports to Flange Width. | Allowable Unit Stress for Direct Flexure in Extreme Fibre. | Proportion of Tabular Safe Load to be Used. |
|---|---|---|---|---|---|
| $\frac{l}{b}$ | p | | $\frac{l}{b}$ | p | |
| 19.37 | 16000 | 1.0 | 65 | 7474 | .47 |
| 20 | 15882 | .97 | 70 | 6835 | .43 |
| 25 | 14897 | .93 | 75 | 6261 | .39 |
| 30 | 13846 | .87 | 80 | 5745 | .36 |
| 35 | 12781 | .80 | 85 | 5281 | .33 |
| 40 | 11739 | .73 | 90 | 4865 | .30 |
| 45 | 10746 | .67 | 95 | 4595 | .29 |
| 50 | 9818 | .61 | 100 | 4154 | .26 |
| 55 | 8963 | .56 | 105 | 3850 | .24 |
| 60 | 8182 | .51 | 110 | 3576 | .22 |

The above table should be used in connection with the Tables of Safe Loads Uniformly Distributed for Cambria I-Beams and Channels, on pages 77 to 93 inclusive, and limits the values found therein under the conditions given above.

EXAMPLE.

Required the safe load for a 15-inch standard I-Beam weighing 42 pounds per foot for a span of 30 feet without lateral supports:

From the data the ratio $\frac{l}{b} = \frac{30 \times 12}{5.5} = 65$

From the above table the proportion of the safe load which the beam can safely support under these conditions is .47. From the Table of Safe Loads for I-Beams, page 82, the safe load for this beam when properly supported laterally is 20940 pounds, which multiplied by .47 gives 9842 pounds as the safe load uniformly distributed under the conditions given, including the weight of the beam or 8582 pounds superimposed load.

## MAXIMUM SAFE LOADS FOR I-BEAMS OF ANY LENGTH AND CORRESPONDING MINIMUM SAFE SPANS BASED UPON CRIPPLING OF THE WEB.

For loads in pounds uniformly distributed including weight of beam.

| Section Number | Depth of Beam. | Weight per Foot. | Maximum Safe Load. | Minimum Span. | Section Number | Depth of Beam. | Weight per Foot. | Maximum Safe Load. | Minimum Span. |
|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Pounds. | Feet. | | Inches. | Pounds. | Pounds. | Feet. |
| B 5 | 3 | 5.5 | 10644 | 1.7 | B105 | 12 | 50 | 163991 | 3.2 |
| | | 6.5 | 16983 | 1.1 | | | 55 | 203806 | 2.8 |
| | | 7.5 | 23884 | .9 | B 53 | 15 | 42 | 85591 | 7.3 |
| B 9 | 4 | 7.5 | 15045 | 2.1 | | | 45 | 104200 | 6.2 |
| | | 8.5 | 21809 | 1.6 | | | 50 | 142044 | 4.8 |
| | | 9.5 | 29349 | 1.2 | | | 55 | 179929 | 4.0 |
| | | 10.5 | 35847 | 1.1 | | | 60 | 213732 | 3.6 |
| B 13 | 5 | 9.75 | 19773 | 2.6 | B109 | 15 | 60 | 157484 | 5.5 |
| | | 12.25 | 37984 | 1.5 | | | 65 | 195147 | 4.6 |
| | | 14.75 | 54380 | 1.2 | | | 70 | 228658 | 4.1 |
| | | | | | | | 75 | 265452 | 3.7 |
| B 17 | 6 | 12.25 | 24826 | 3.1 | | | 80 | 301820 | 3.4 |
| | | 14.75 | 42634 | 2.0 | | | | | |
| | | 17.25 | 59857 | 1.6 | B113 | 15 | 80 | 240024 | 4.6 |
| | | | | | | | 85 | 275411 | 4.2 |
| B 21 | 7 | 15 | 30192 | 3.7 | | | 90 | 308939 | 3.9 |
| | | 17.5 | 47720 | 2.5 | | | 95 | 344691 | 3.6 |
| | | 20 | 66478 | 1.9 | | | 100 | 380169 | 3.4 |
| B 25 | 8 | 18. | 35925 | 4.2 | B 65 | 18 | 55 | 107758 | 8.8 |
| | | 20.25 | 52072 | 3.1 | | | 60 | 152031 | 6.6 |
| | | 22.75 | 69914 | 2.4 | | | 65 | 188299 | 5.5 |
| | | 25.25 | 87403 | 2.1 | | | 70 | 224737 | 4.9 |
| B 29 | 9 | 21 | 41992 | 4.8 | B 73 | 20 | 65 | 127592 | 9.6 |
| | | 25 | 69224 | 3.1 | | | 70 | 178434 | 7.3 |
| | | 30 | 104631 | 2.3 | | | 75 | 201484 | 6.7 |
| | | 35 | 139074 | 1.9 | | | | | |
| | | | | | B121 | 20 | 80 | 179940 | 8.7 |
| B 33 | 10 | 25 | 48406 | 5.4 | | | 85 | 210096 | 7.7 |
| | | 30 | 83739 | 3.4 | | | 90 | 250558 | 6.6 |
| | | 35 | 120792 | 2.6 | | | 95 | 285966 | 6.0 |
| | | 40 | 156930 | 2.2 | | | 100 | 321253 | 5.5 |
| B 41 | 12 | 31.5 | 62193 | 6.2 | B 89 | 24 | 80 | 126012 | 14.7 |
| | | 35 | 89412 | 4.5 | | | 85 | 163791 | 11.8 |
| | | 40 | 125695 | 3.5 | | | 90 | 197821 | 10.1 |
| *B105* | *12* | *40* | 97469 | 4.9 | | | 95 | 232873 | 8.8 |
| | | *45* | 133560 | 3.8 | | | 100 | 283596 | 7.9 |

## MAXIMUM SAFE LOAD FOR STANDARD CHANNELS OF ANY LENGTH AND CORRESPONDING MINIMUM SAFE SPANS BASED UPON CRIPPLING OF THE WEB.

For loads in pounds uniformly distributed including weight of channel.

| Section Number | Depth of Beam. | Weight per Foot. | Maximum Load. | Minimum Span. | Section Number | Depth of Beam. | Weight per Foot. | Maximum Load. | Minimum Span. |
|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Pounds. | Pounds. | Feet. | | Inches. | Pounds. | Pounds. | Feet. |
| C5 | 3 | 4 | 10692 | 1.1 | C25 | 8 | 18.75 | 79348 | 1.5 |
| | | 5 | 17016 | 0.8 | | | 21.25 | 96698 | 1.3 |
| | | 6 | 23909 | .6 | | | | | |
| | | | | | C29 | 9 | 13.25 | 28044 | 4.0 |
| C9 | 4 | 5.25 | 14032 | 1.4 | | | 15 | 41483 | 2.9 |
| | | 6.25 | 20868 | 1.1 | | | 20 | 77711 | 1.8 |
| | | 7.25 | 28424 | .9 | | | 25 | 115740 | 1.4 |
| 13 | 5 | 6.5 | 19231 | 1.6 | C33 | 10 | 15 | 30461 | 4.7 |
| | | 9 | 34382 | 1.1 | | | 20 | 65360 | 2.6 |
| | | 11.5 | 52036 | .9 | | | 25 | 102947 | 1.9 |
| | | | | | | | 30 | 139563 | 1.6 |
| 17 | 6 | 8 | 20024 | 2.3 | | | 35 | 173036 | 1.4 |
| | | 10.5 | 38027 | 1.4 | | | | | |
| | | 13 | 55414 | 1.1 | C41 | 12 | 20.5 | 41173 | 5.5 |
| | | 15.5 | 72401 | 1.0 | | | 25 | 73588 | 3.5 |
| | | | | | | | 30 | 109976 | 2.6 |
| 1 | 7 | 9.75 | 22865 | 2.8 | | | 35 | 148961 | 2.1 |
| | | 12.25 | 42273 | 1.7 | | | 40 | 184279 | 1.9 |
| | | 14.75 | 59506 | 1.4 | | | | | |
| | | 17.25 | 78006 | 1.2 | C53 | 15 | 33 | 82528 | 5.4 |
| | | 19.75 | 94532 | 1.1 | | | 35 | 93615 | 4.9 |
| | | | | | | | 40 | 114450 | 4.3 |
| 5 | 8 | 11.25 | 25494 | 3.4 | | | 45 | 165466 | 3.2 |
| | | 13.75 | 43638 | 2.2 | | | 50 | 203148 | 2.8 |
| | | 16.25 | 61676 | 1.7 | | | 55 | 245311 | 2.5 |

## COEFFICIENTS FOR DEFLECTION IN INCHES FOR CAMBRIA SHAPES, USED AS BEAMS SUBJECTED TO SAFE LOADS UNIFORMLY DISTRIBUTED.

| Distance between Supports in feet. | Coefficient for Fibre Stress of 16 000 lbs. per Square Inch. | Coefficient for Fibre Stress of 12 500 lbs. per Square Inch. | Distance between Supports in Feet. | Coefficient for Fibre Stress of 16 000 lbs. per Square Inch. | Coefficient for Fibre Stress of 12 500 lbs. per Square Inch. |
|---|---|---|---|---|---|
| L | H | H′ | L | H | H′ |
| 4 | .265 | .207 | 23 | 8.756 | 6.841 |
| 5 | .414 | .323 | 24 | 9.534 | 7.448 |
| 6 | .596 | .466 | 25 | 10.345 | 8.082 |
| 7 | .811 | .634 | 26 | 11.189 | 8.741 |
| 8 | 1.059 | .828 | 27 | 12.066 | 9.427 |
| 9 | 1.341 | 1.047 | 28 | 12.977 | 10.138 |
| 10 | 1.655 | 1.293 | 29 | 13.920 | 10.875 |
| 11 | 2.003 | 1.565 | 30 | 14.897 | 11.638 |
| 12 | 2.383 | 1.862 | 31 | 15.906 | 12.427 |
| 13 | 2.797 | 2.185 | 32 | 16.949 | 13.241 |
| 14 | 3.244 | 2.534 | 33 | 18.025 | 14.082 |
| 15 | 3.724 | 2.909 | 34 | 19.134 | 14.948 |
| 16 | 4.237 | 3.310 | 35 | 20.276 | 15.841 |
| 17 | 4.783 | 3.737 | 36 | 21.451 | 16.759 |
| 18 | 5.363 | 4.190 | 37 | 22.659 | 17.703 |
| 19 | 5.975 | 4.668 | 38 | 23.901 | 18.672 |
| 20 | 6.621 | 5.172 | 39 | 25.175 | 19.668 |
| 21 | 7.299 | 5.703 | 40 | 26.483 | 20.690 |
| 22 | 8.011 | 6.259 | | | |

The above coefficients are for use in obtaining the deflection of steel shapes subjected to transverse strain, under their uniformly distributed safe loads for extreme fibre stresses of **16 000** pounds and **12 500** pounds per square inch; the modulus of elasticity being **29 000 000.**

To find the deflection of any shape that is symmetrical about its neutral axis under the above conditions of loading when used as a beam, such as I-Beams, Channels, etc., divide the coefficient in the table corresponding to the given span and fibre stress, by the depth of the beam in inches. The result will be the deflection in inches.

To find the deflection of any shape that is unsymmetrical about its neutral axis when used as a beam, under the above conditions of loading such as T-Bars, Angles, etc., divide the coefficient in the table corresponding to the given span and fibre stress by twice the distance of the most remote fibre from the neutral axis, expressed in inches.

If in construction, the beam is placed in position in the usual manner upon its end supports without special scaffolding or falsework between them, it will deflect somewhat by reason of its own weight, and upon the addition of external loading a further deflection will occur.

The deflections obtained as above described are the total deflections *due to* the weight of the beam itself and the superimposed safe load *uniformly distributed.*

Thus to find from the preceding table the deflection in inches for Cambria shapes used as beams under their safe loads uniformly distributed including the weight of the beam:

Let D = deflection in inches.
L = length between supports in feet.
H = coefficient for deflection from table for fibre stress of 16 000 pounds per square inch.
H′ = coefficient for deflection from table for fibre stress of 12 500 pounds per square inch.
d = depth of beam in inches for symmetrical sections.
$x_1$ = distances in inches from neutral axis to most remote fibre for unsymmetrical sections.

FOR SYMMETRICAL SECTIONS.

For fibre stress of 16 000 pounds per square inch $D = \frac{H}{d}$

For fibre stress of 12 500 pounds per square inch $D = \frac{H'}{d}$

FOR UNSYMMETRICAL SECTIONS.

For fibre stress of 16 000 pounds per square inch $D = \frac{H}{2x_1}$

For fibre stress of 12 500 pounds per square inch $D = \frac{H'}{2x_1}$

EXAMPLES.

*Case I.*—To find the deflection of a 9″ I-Beam weighing 30 pounds per foot, for a span of 15 feet and a maximum fibre stress of 16 000 pounds per square inch, under its safe load uniformly distributed.

From the above table the deflection coefficient for this case is found to be 3.724, which divided by 9, the depth of the beam in inches, gives .414, which is the required deflection in inches.

The safe load for this beam under the conditions named is 16 100 pounds including the weight of the beam itself as stated in the Tables of Safe Loads for Cambria I-Beams on page 80.

*Case II.*—To find the deflection of a 6″ × 4″ × ½″ angle, supported at the ends on its short leg as a horizontal base, for a span of 9 feet and a maximum fibre stress of 16 000 pounds per square inch under its safe load uniformly distributed including its own weight.

From the table of "Properties of Angles" on page 177 the distance x′ from the neutral axis to the back of the shorter leg is found to be, 1.99 inches, which subtracted from the length of long leg, 6 inches gives 4.01 as the distance $x_1$ from the neutral axis to the most remote fibre. From the above table the deflection coefficient for this case is found to be 1.341, which divided by 8.02, twice $x_1$, gives .167, which is the required deflection in inches.

NOTE.—For deflections of Beams, Channels and Z-Bars due to any central or uniform load see coefficients of deflection N and N′ in the Tables of Properties relating to these sections and the accompanying explanations.

For deflections *of any symmetrical* beams due to various systems of *loading, see general formulæ and diagrams* on pages 138 to 143 inclusive.

# TABLES OF SAFE LOADS FOR CAMBRIA I-BEAMS AND CHANNELS AND SPACING FOR CAMBRIA I-BEAMS, PAGES 77 TO 137 INCLUSIVE.

## Tables of Safe Loads.

The tables of Safe Loads for Cambria I-Beams and Channels have been calculated for all sizes and weights of both standard and standard-special sections, and give the safe loads in pounds uniformly distributed for all usual spans, based upon extreme fibre stresses of 16 000 pounds per square inch.

These loads include the weight of the beam or channel which should be deducted in order to obtain the net load which the beam will safely carry. In order to obtain the net live load which the beam is capable of safely sustaining the weight of the floor materials should also be deducted. Weights of hollow tile floor arches and fire-proofing material are given on page 54, to which should be added the weight of plastering, filling on top of arches and the weight of the material forming the surface of the floor, in order to obtain the dead load of materials in figuring fire-proof floors, in addition to the weight of the beam.

A table of superimposed loads per square foot, exclusive of the weight of materials in accordance with the usual practice for different classes of buildings, is given on page 53.

The Tables of Safe Loads for Cambria I-Beams and Channels and Tables of Spacing of Cambria I-Beams are calculated on the assumption that proper provision has been made for preventing lateral deflection by means of tie rods or other braces, spaced at distances apart not greater than twenty times the flange width. If the lateral supports are spaced at greater distances than this the unit stresses and safe loads should be reduced in accordance with the explanations and tables therefor on pages 64 and 65.

The thrust of floor arches, which is considerable, particularly in the case of long spans or distances between tie rods, should be taken into account where it tends to produce lateral flexure of the floor beams. Throughout the body of the floor the thrusts will ordinarily counterbalance each other, but in the extreme beams, where unsupported laterally, between the tie rods or braces, this additional stress should be *provided for by* a corresponding reduction in the stresses due to *vertical loading.*

Explanations of this and a formula for reducing the unit stresses from vertical loading, on account of the additional stresses caused by horizontal forces, are given on pages 60 to 63 inclusive.

In some instances the allowable deflection will govern the design rather than the transverse strength, as in the case of beams carrying plastered ceilings, in which the deflection should be limited to $\frac{1}{360}$ inch per foot of span, or $\frac{1}{360}$ of the distance between supports in order to avoid cracking the plaster.

This limit of deflection is indicated in the tables by full horizontal lines, the figures below which correspond to loads or spacings for the given spans that will produce greater deflections than the allowable limit for plastered ceilings.

The deflection limits of the Tables of Safe Loads have been calculated for the total loads, including the weight of the beam. The superimposed live load will not produce all of this deflection, and therefore the deflection limit of the tables includes an element of safety for the reason that the beams will be deflected, after being put in place, by their own weight and that of the floor materials before the plastering is applied.

In cases where the deflection limits the use of the beam for the safe loads corresponding to the fibre stresses of the tables, the beam may be used with a less load such as to produce only the allowable deflection. The lesser load corresponding to the limit of deflection may be obtained for any span from the Table of Safe Loads as follows:

$$W = \frac{W_s \times L^2}{L_1^2}$$

in which

$W$ = safe load in pounds for the limit of deflection for plastered ceilings = $\frac{1}{360}$ of the span.

$W_s$ = safe load of tables next above the line giving the limit of deflection.

$L$ = length of span in feet corresponding to $W_s$ from the table.

$L_1$ = length of span for the case under consideration.

This may also be expressed by the following:

RULE.

*Multiply the safe load next above the heavy line of the tables by the square of the corresponding span in feet and divide the product*

*by the square of the required span. The result will be the required load corresponding to the limit of allowable deflection for plastered ceilings.*

A Table of Deflections for Cambria shapes used as beams, subjected to their safe loads uniformly distributed, and accompanying explanations with examples, is given on pages 70 and 71.

### Tables of Spacing of Cambria I-Beams.

Tables of Spacing of I-Beams for intensities of loading of 100, 125, 150 and 175 pounds per square foot, corresponding to spans from 4 to 36 feet, are given on pages 94 to 137 inclusive.

For any given size of beam the spacing or distances from centers to centers for different intensities of loading varies inversely as the load, so that the spacing for any intensity of loading may be found from the tabular spacing by proportion as stated in the notes at the foot of the tables.

## EXAMPLES OF APPLICATION OF TABLES OF SAFE LOADS AND TABLES OF SPACING.

### Example I.

What is the proper size of beam with a clear span of 24 feet to carry a superimposed load of 30 000 pounds uniformly distributed, the deflection to be such as not to crack a plastered ceiling?

From the Tables of Safe Loads for Cambria I-Beams, page 82, it is found that a 15-inch standard beam of this length, weighing 60 pounds per foot, will carry a gross load of 31 910 pounds, and the weight of the beam itself is $60 \times 24 = 1440$ pounds. Thus the net load may be 30 470 pounds, so that this is the proper size for the conditions named, as its deflection is within the allowable limit, which is shown to be at a span of 30 feet as indicated by the horizontal line on the table.

Similarly it may be found from page 83 that a 15 inch special beam, of 60 pounds per foot, will more than suffice, but as this section is not regularly kept in stock the standard 15-inch 60 pound beam should be ordered if prompt delivery is wanted.

It may also be found from page 85 that an 18 inch 55-pound beam will amply suffice, and as this is both stiffer and lighter than the 15-inch 60-pound beams, it could be used with economy if otherwise suitable for the location.

EXAMPLE II.

s the safe load for an 8 inch standard I-Beam weighing 18.0
:r foot for a span of 20 feet, the deflection to be such as not
ı plastered ceiling?

he Tables of Safe Loads, page 79, it is found that the safe
he beam in question is 7 580 pounds, but this value is below
/hich indicates the span corresponding to the allowable limit
on.

uting the proper values in the formula for obtaining the
load corresponding to the allowable deflection, as given on
we have

$$W = \frac{W_s \times L^3}{L_1^2} = \frac{9\,480 \times 16^2}{20^2} = 6\,067 \text{ pounds},$$

the safe load required.

EXAMPLE III.

ed the best arrangement of beams for the floor system of a
40 feet wide x 88 feet deep to safely support a live load of 100
er square foot, using 10-inch tile arches resting on 12-inch

:ight of the floor materials will be about 50 pounds per square
wing 39 pounds for the arch and 11 pounds for the other
, or a total load of 150 pounds per square foot to be carried by
s.

the Table of Spacing for I-Beams for a uniform load of 150
)er square foot, page 120, it is seen that 12-inch standard
weighing 31.5 pounds per foot, and spaced 6.4 feet apart from
) centers, can be used with a span of 20 feet.

ill require one row of interior columns lengthwise of building.

port the beams at the center of the building will require a
rder beams resting on the columns. Assume the columns 22
:, thus dividing the building into 8 bays, four on each side of
r.

ad on each girder will be

$$\frac{40}{2} \times 22 \times 150 = 66\,000 \text{ pounds.}$$

From the Table of Safe Loads, page 82, it is found that this will require two 15-inch standard I-Beams, each weighing 60 pounds per foot.

On account of the advisability of spacing the floor beams equally this arrangement of columns and girders would reduce their distances to $\frac{22}{4} = 5\frac{1}{2}$ feet center to center, so that 10-inch I-Beams weighing 35 pounds per foot might be used for the body of the floor, as may be seen by reference to the Table of Spacing of Cambria I-Beams, page 119, which gives the allowable spacing for these conditions to be 5.2 feet. The 10-inch 35-pound beams under these conditions will, however, deflect to the allowable limit for plastered ceilings, besides which they are heavier than the 12-inch 31.5-pound beams first considered, so that the latter will be the stiffest and most economical.

Although the load on the girder is not uniformly distributed, but concentrated at three points between the supports, the bending moment in this case will be the same as if the load were figured to be distributed uniformly, and for similar cases with different spacings the moments would be very nearly identical.

### Example IV.

What is the proper spacing between centers of 10-inch standard I-Beams weighing 25 pounds per foot for a span of 18 feet to carry a superimposed load of 100 pounds per square foot in addition to the weight of the floor materials, consisting of an 8-inch tile arch with filling and flooring weighing about 50 lbs. per square foot, this being equivalent to a total load of 150 pounds per square foot?

From the Tables of Spacings of Cambria I-Beams, page 119, it is found that the proper distance from center to center of beams is 5.4 feet, so that a spacing of 5 feet apart will be proper.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of beam.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 Inch No. B 5. | | | 4 Inch No. B 9. | | | |
| | 5.5 lbs. | 6.5 lbs. | 7.5 lbs. | 7.5 lbs. | 8.5 lbs. | 9.5 lbs. | 10.5 lbs. |
| 4 | 4410 | 4780 | 5180 | 7950 | 8470 | 9000 | 9520 |
| 5 | 3530 | 3830 | 4140 | 6360 | 6780 | 7200 | 7610 |
| 6 | 2940 | 3190 | 3450 | 5300 | 5650 | 6000 | 6350 |
| 7 | 2520 | 2730 | 2960 | 4540 | 4840 | 5140 | 5440 |
| 8 | 2210 | 2390 | 2590 | 3980 | 4240 | 4500 | 4760 |
| 9 | 1960 | 2130 | 2300 | 3530 | 3770 | 4000 | 4230 |
| 10 | 1770 | 1910 | 2070 | 3180 | 3390 | 3600 | 3810 |
| 11 | 1600 | 1740 | 1880 | 2890 | 3080 | 3270 | 3460 |
| 12 | 1470 | 1590 | 1730 | 2650 | 2820 | 3000 | 3170 |
| 13 | 1360 | 1470 | 1590 | 2450 | 2610 | 2770 | 2930 |
| 14 | 1260 | 1370 | 1480 | 2270 | 2420 | 2570 | 2720 |
| 15 | 1180 | 1280 | 1380 | 2120 | 2260 | 2400 | 2540 |
| 16 | 1100 | 1200 | 1290 | 1990 | 2120 | 2250 | 2380 |
| 17 | 1040 | 1130 | 1220 | 1870 | 1990 | 2120 | 2240 |
| 18 | 980 | 1060 | 1150 | 1770 | 1880 | 2000 | 2120 |
| 19 | 930 | 1010 | 1090 | 1670 | 1780 | 1890 | 2000 |
| 20 | 880 | 960 | 1040 | 1590 | 1690 | 1800 | 1900 |
| 21 | 840 | 910 | 990 | 1510 | 1610 | 1710 | 1810 |

For safe loads below the heavy lines, the deflections will be greater than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of beam.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | |
|---|---|---|---|---|---|---|
| | 5 Inch No. B 13. | | | 6 Inch No. B 17. | | |
| | 9.75 lbs. | 12.25 lbs. | 14.75 lbs. | 12.25 lbs. | 14.75 lbs. | 17.25 lbs. |
| 4 | 12900 | 14520 | 16160 | 19370 | 21320 | 23280 |
| 5 | 10320 | 11620 | 12930 | 15490 | 17050 | 18620 |
| 6 | 8600 | 9680 | 10770 | 12910 | 14210 | 15520 |
| 7 | 7370 | 8300 | 9230 | 11070 | 12180 | 13300 |
| 8 | 6450 | 7260 | 8080 | 9680 | 10660 | 11640 |
| 9 | 5730 | 6460 | 7180 | 8610 | 9470 | 10350 |
| 10 | 5160 | 5810 | 6460 | 7750 | 8530 | 9310 |
| 11 | 4690 | 5280 | 5880 | 7040 | 7750 | 8460 |
| 12 | 4300 | 4840 | 5390 | 6460 | 7110 | 7760 |
| 13 | 3970 | 4470 | 4970 | 5960 | 6560 | 7160 |
| 14 | 3680 | 4150 | 4620 | 5530 | 6090 | 6650 |
| 15 | 3440 | 3870 | 4310 | 5160 | 5680 | 6210 |
| 16 | 3220 | 3630 | 4040 | 4840 | 5330 | 5820 |
| 17 | 3030 | 3420 | 3800 | 4560 | 5020 | 5480 |
| 18 | 2870 | 3230 | 3590 | 4300 | 4740 | 5170 |
| 19 | 2720 | 3060 | 3400 | 4080 | 4490 | 4900 |
| 20 | 2580 | 2900 | 3230 | 3870 | 4260 | 4660 |
| 21 | 2460 | 2770 | 3080 | 3690 | 4060 | 4430 |
| 22 | 2340 | 2640 | 2940 | 3520 | 3880 | 4230 |
| 23 | 2240 | 2530 | 2810 | 3370 | 3710 | 4050 |
| 24 | 2150 | 2420 | 2690 | 3230 | 3550 | 3880 |
| 25 | 2060 | 2320 | 2590 | 3100 | 3410 | 3720 |
| 26 | 1980 | 2230 | 2490 | 2980 | 3280 | 3580 |
| 27 | 1910 | 2150 | 2390 | 2870 | 3160 | 3450 |
| 28 | .... | .... | .... | 2770 | 3050 | 3330 |
| 29 | .... | .... | .... | 2670 | 2940 | 3210 |

*For safe loads* below the heavy lines, the deflections will be greater *than the allowable* limit for plastered ceilings = $\frac{1}{360}$ span.

## AFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

: loads below are figured for fibre stress of 16 000 pounds per inch and include weight of beam.

### STANDARD I-BEAMS.

| 7 Inch No. B 21. | | | 8 Inch No. B 25. | | | |
|---|---|---|---|---|---|---|
| 15 lbs. | 17.5 lbs. | 20 lbs. | 18.00 lbs. | 20.25 lbs. | 22.75 lbs. | 25.25 lbs. |
| 27600 | 29850 | 32140 | 37920 | 40130 | 42740 | 45360 |
| 22080 | 23880 | 25710 | 30330 | 32100 | 34190 | 36290 |
| 18400 | 19900 | 21430 | 25280 | 26750 | 28500 | 30240 |
| 15770 | 17060 | 18370 | 21670 | 22930 | 24420 | 25920 |
| 13800 | 14930 | 16070 | 18960 | 20060 | 21370 | 22680 |
| 12270 | 13270 | 14280 | 16850 | 17830 | 19000 | 20160 |
| 11040 | 11940 | 12860 | 15170 | 16050 | 17100 | 18140 |
| 10040 | 10860 | 11690 | 13790 | 14590 | 15540 | 16490 |
| 9200 | 9950 | 10710 | 12640 | 13380 | 14250 | 15120 |
| 8490 | 9190 | 9890 | 11670 | 12350 | 13150 | 13960 |
| 7890 | 8530 | 9180 | 10830 | 11470 | 12210 | 12960 |
| 7360 | 7960 | 8570 | 10110 | 10700 | 11400 | 12100 |
| 6900 | 7460 | 8030 | 9480 | 10030 | 10690 | 11340 |
| 6490 | 7020 | 7560 | 8920 | 9440 | 10060 | 10670 |
| 6130 | 6630 | 7140 | 8430 | 8920 | 9500 | 10080 |
| 5810 | 6280 | 6770 | 7980 | 8450 | 9000 | 9550 |
| 5520 | 5970 | 6430 | 7580 | 8030 | 8550 | 9070 |
| 5260 | 5690 | 6120 | 7220 | 7640 | 8140 | 8640 |
| 5020 | 5430 | 5840 | 6890 | 7300 | 7770 | 8250 |
| 4800 | 5190 | 5590 | 6590 | 6980 | 7430 | 7890 |
| 4600 | 4980 | 5360 | 6320 | 6690 | 7120 | 7560 |
| 4420 | 4780 | 5140 | 6070 | 6420 | 6840 | 7260 |
| 4250 | 4590 | 4940 | 5830 | 6170 | 6580 | 6980 |
| 4090 | 4420 | 4760 | 5620 | 5940 | 6330 | 6720 |
| 3940 | 4260 | 4590 | 5420 | 5730 | 6110 | 6480 |
| 3810 | 4120 | 4430 | 5230 | 5530 | 5900 | 6260 |

safe loads below the heavy lines, the deflections will be greater
ie allowable limit for plastered ceilings = $\frac{1}{360}$ span.
: loads above *dotted line* are greater than safe loads for web crip-
*s shown on pages 66 to 68* inclusive.

## SAFE LOADS IN POUNDS UNIFORMLY DI TRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 poun square inch and include weight of beam.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 9 Inch No. B 29. | | | | 10 Inch No. B 33 | | | |
| | 21 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | |
| 8 | 25160 | 27240 | 30180 | 33120 | .... | .... | .... | |
| 9 | 22370 | 24210 | 26830 | 29440 | .... | .... | .... | |
| 10 | 20130 | 21790 | 24150 | 26500 | 26050 | 28620 | 31240 | |
| 11 | 18300 | 19810 | 21950 | 24090 | 23680 | 26020 | 28400 | |
| 12 | 16770 | 18160 | 20120 | 22080 | 21710 | 23850 | 26030 | |
| 13 | 15480 | 16760 | 18570 | 20380 | 20040 | 22020 | 24030 | |
| 14 | 14380 | 15570 | 17250 | 18930 | 18610 | 20450 | 22310 | |
| 15 | 13420 | 14530 | 16100 | 17670 | 17360 | 19080 | 20830 | |
| 16 | 12580 | 13620 | 15090 | 16560 | 16280 | 17890 | 19520 | |
| 17 | 11840 | 12820 | 14200 | 15590 | 15320 | 16840 | 18380 | |
| 18 | 11180 | 12110 | 13410 | 14720 | 14470 | 15900 | 17350 | |
| 19 | 10590 | 11470 | 12710 | 13950 | 13710 | 15070 | 16440 | |
| 20 | 10064 | 10900 | 12070 | 13250 | 13020 | 14310 | 15620 | |
| 21 | 9590 | 10380 | 11500 | 12620 | 12400 | 13630 | 14880 | |
| 22 | 9150 | 9910 | 10980 | 12050 | 11840 | 13010 | 14200 | |
| 23 | 8750 | 9480 | 10500 | 11520 | 11320 | 12450 | 13580 | |
| 24 | 8390 | 9080 | 10060 | 11040 | 10850 | 11930 | 13020 | |
| 25 | 8050 | 8720 | 9660 | 10600 | 10420 | 11450 | 12500 | |
| 26 | 7740 | 8380 | 9290 | 10190 | 10020 | 11010 | 12020 | |
| 27 | 7460 | 8070 | 8940 | 9810 | 9650 | 10600 | 11570 | |
| 28 | 7190 | 7780 | 8620 | 9460 | 9300 | 10220 | 11160 | |
| 29 | 6940 | 7510 | 8330 | 9140 | 8980 | 9870 | 10770 | |
| 30 | 6710 | 7260 | 8050 | 8830 | 8680 | 9540 | 10410 | |
| 31 | 6490 | 7030 | 7790 | 8550 | 8400 | 9230 | 10080 | |
| 32 | .... | .... | .... | .... | 8140 | 8950 | 9760 | |
| 33 | .... | .... | .... | .... | 7890 | 8670 | 9470 | |

*For safe loads* below the heavy lines, the deflections will be g *than the allowable* limit for plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of beam.

| Distance between supports in feet. | STANDARD I-BEAMS. 12 Inch No. B 41. | | | STANDARD-SPECIAL I-BEAMS. 12 Inch No. B 105. | | | |
|---|---|---|---|---|---|---|---|
| | 31.5 lbs. | 35 lbs. | 40 lbs. | 40 lbs. | 45 lbs. | 50 lbs. | 55 lbs. |
| 10 | 38370 | 40580 | 43720 | 47810 | 50790 | 53930 | 57070 |
| 11 | 34880 | 36890 | 39740 | 43470 | 46180 | 49030 | 51880 |
| 12 | 31970 | 33820 | 36430 | 39840 | 42330 | 44940 | 47560 |
| 13 | 29510 | 31220 | 33630 | 36780 | 39070 | 41480 | 43900 |
| 14 | 27400 | 28990 | 31230 | 34150 | 36280 | 38520 | 40760 |
| 15 | 25580 | 27050 | 29140 | 31880 | 33860 | 35950 | 38040 |
| 16 | 23980 | 25360 | 27320 | 29880 | 31750 | 33710 | 35670 |
| 17 | 22570 | 23870 | 25720 | 28130 | 29880 | 31720 | 33570 |
| 18 | 21310 | 22540 | 24290 | 26560 | 28220 | 29960 | 31700 |
| 19 | 20190 | 21360 | 23010 | 25160 | 26730 | 28380 | 30040 |
| 20 | 19180 | 20290 | 21860 | 23910 | 25400 | 26960 | 28530 |
| 21 | 18270 | 19320 | 20820 | 22770 | 24190 | 25680 | 27170 |
| 22 | 17440 | 18450 | 19870 | 21730 | 23090 | 24510 | 25940 |
| 23 | 16680 | 17640 | 19010 | 20790 | 22080 | 23450 | 24810 |
| 24 | 15990 | 16910 | 18220 | 19920 | 21160 | 22470 | 23780 |
| 25 | 15350 | 16230 | 17490 | 19130 | 20320 | 21570 | 22830 |
| 26 | 14760 | 15610 | 16810 | 18390 | 19540 | 20740 | 21950 |
| 27 | 14210 | 15030 | 16190 | 17710 | 18810 | 19970 | 21140 |
| 28 | 13700 | 14490 | 15610 | 17080 | 18140 | 19260 | 20380 |
| 29 | 13230 | 13990 | 15070 | 16490 | 17510 | 18600 | 19680 |
| 30 | 12790 | 13530 | 14570 | 15940 | 16930 | 17980 | 19020 |
| 31 | 12380 | 13090 | 14100 | 15420 | 16380 | 17400 | 18410 |
| 32 | 11990 | 12680 | 13660 | 14940 | 15870 | 16850 | 17830 |
| 33 | 11630 | 12300 | 13250 | 14490 | 15390 | 16340 | 17290 |
| 34 | 11280 | 11940 | 12860 | 14060 | 14940 | 15860 | 16780 |
| 35 | 10960 | 11590 | 12490 | 13660 | 14510 | 15410 | 16300 |
| 36 | 10660 | 11270 | 12140 | 13280 | 14110 | 14980 | 15850 |

For safe *loads below the heavy lines*, the deflections will be greater *than the allowable limit for plastered* ceilings = $\frac{1}{800}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of **16 000** pounds per square inch and include weight of beam.

| Distance between supports in feet. | STANDARD I-BEAM. 15 Inch No. B 53. | | | | |
|---|---|---|---|---|---|
| | 42 lbs. | 45 lbs. | 50 lbs. | 55 lbs. | 60 lbs. |
| 10 | 62830 | 64830 | 68750 | 72670 | 76600 |
| 11 | 57120 | 58940 | 62500 | 66070 | 69630 |
| 12 | 52360 | 54030 | 57290 | 60560 | 63830 |
| 13 | 48330 | 49870 | 52890 | 55900 | 58920 |
| 14 | 44880 | 46310 | 49110 | 51910 | 54710 |
| 15 | 41880 | 43220 | 45840 | 48450 | 51060 |
| 16 | 39270 | 40520 | 42970 | 45420 | 47870 |
| 17 | 36960 | 38140 | 40440 | 42750 | 45060 |
| 18 | 34900 | 36020 | 38200 | 40370 | 42550 |
| 19 | 33070 | 34120 | 36190 | 38250 | 40310 |
| 20 | 31410 | 32420 | 34380 | 36340 | 38300 |
| 21 | 29920 | 30870 | 32740 | 34610 | 36470 |
| 22 | 28560 | 29470 | 31250 | 33030 | 34820 |
| 23 | 27320 | 28190 | 29890 | 31600 | 33300 |
| 24 | 26180 | 27010 | 28650 | 30280 | 31910 |
| 25 | 25130 | 25930 | 27500 | 29070 | 30640 |
| 26 | 24160 | 24940 | 26440 | 27950 | 29460 |
| 27 | 23270 | 24010 | 25460 | 26920 | 28370 |
| 28 | 22440 | 23150 | 24550 | 25960 | 27360 |
| 29 | 21660 | 22360 | 23710 | 25060 | 26410 |
| 30 | 20940 | 21610 | 22920 | 24220 | 25530 |
| 31 | 20270 | 20910 | 22180 | 23440 | 24710 |
| 32 | 19630 | 20260 | 21490 | 22710 | 23940 |
| 33 | 19040 | 19650 | 20830 | 22020 | 23210 |
| 34 | 18480 | 19070 | 20220 | 21370 | 22530 |
| 35 | 17950 | 18520 | 19640 | 20760 | 21880 |
| 36 | 17450 | 18010 | 19100 | 20190 | 21280 |

*For safe loads* below the heavy lines, the deflections will be greater *than the allowable* limit for plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of beam.

| Distance between supports in feet. | STANDARD-SPECIAL I-BEAM. 15 Inch No. B 109. | | | | |
|---|---|---|---|---|---|
| | 60 lbs. | 65 lbs. | 70 lbs. | 75 lbs. | 80 lbs. |
| 10 | 86610 | 90470 | 94390 | 98310 | 102230 |
| 11 | 78740 | 82240 | 85810 | 89370 | 92940 |
| 12 | 72180 | 75390 | 78660 | 81920 | 85190 |
| 13 | 66630 | 69590 | 72610 | 75620 | 78640 |
| 14 | 61870 | 64620 | 67420 | 70220 | 73020 |
| 15 | 57740 | 60310 | 62920 | 65540 | 68150 |
| 16 | 54130 | 56540 | 58990 | 61440 | 63890 |
| 17 | 50950 | 53220 | 55520 | 57830 | 60140 |
| 18 | 48120 | 50260 | 52440 | 54620 | 56790 |
| 19 | 45590 | 47610 | 49680 | 51740 | 53810 |
| 20 | 43310 | 45230 | 47190 | 49150 | 51120 |
| 21 | 41240 | 43080 | 44950 | 46810 | 48680 |
| 22 | 39370 | 41120 | 42900 | 44690 | 46470 |
| 23 | 37660 | 39330 | 41040 | 42740 | 44450 |
| 24 | 36090 | 37690 | 39330 | 40960 | 42600 |
| 25 | 34650 | 36190 | 37750 | 39320 | 40890 |
| 26 | 33310 | 34790 | 36300 | 37810 | 39320 |
| 27 | 32080 | 33510 | 34960 | 36410 | 37860 |
| 28 | 30930 | 32310 | 33710 | 35110 | 36510 |
| 29 | 29870 | 31200 | 32550 | 33900 | 35250 |
| 30 | 28870 | 30160 | 31460 | 32770 | 34080 |
| 31 | 27940 | 29180 | 30450 | 31710 | 32980 |
| 32 | 27070 | 28270 | 29500 | 30720 | 31950 |
| 33 | 26250 | 27410 | 28600 | 29790 | 30980 |
| 34 | 25470 | 26610 | 27760 | 28910 | 30070 |
| 35 | 24750 | 25850 | 26970 | 28090 | 29210 |
| 36 | 24060 | 25130 | 26220 | 27310 | 28400 |

For safe loads below the heavy lines, the deflections will be greater *than the allowable limit for* plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds p square inch and include weight of beam.

| Distance between supports in feet. | STANDARD-SPECIAL I-BEAM. 15 Inch No. B 113. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 112230 | 116030 | 119960 | 123880 | 127800 |
| 11 | 102030 | 105490 | 109050 | 112620 | 116180 |
| 12 | 93520 | 96700 | 99960 | 103230 | 106500 |
| 13 | 86330 | 89260 | 92270 | 95290 | 98310 |
| 14 | 80160 | 82880 | 85680 | 88480 | 91280 |
| 15 | 74820 | 77360 | 79970 | 82580 | 85200 |
| 16 | 70140 | 72520 | 74970 | 77420 | 79870 |
| 17 | 66020 | 68260 | 70560 | 72870 | 75180 |
| 18 | 62350 | 64460 | 66640 | 68820 | 71000 |
| 19 | 59070 | 61070 | 63130 | 65200 | 67260 |
| 20 | 56110 | 58020 | 59980 | 61940 | 63900 |
| 21 | 53440 | 55250 | 57120 | 58990 | 60860 |
| 22 | 51010 | 52740 | 54530 | 56310 | 58090 |
| 23 | 48800 | 50450 | 52150 | 53860 | 55560 |
| 24 | 46760 | 48350 | 49980 | 51620 | 53250 |
| 25 | 44890 | 46410 | 47980 | 49550 | 51120 |
| 26 | 43170 | 44630 | 46140 | 47650 | 49150 |
| 27 | 41570 | 42980 | 44430 | 45880 | 47330 |
| 28 | 40080 | 41440 | 42840 | 44240 | 45640 |
| 29 | 38700 | 40010 | 41360 | 42720 | 44070 |
| 30 | 37410 | 38680 | 39990 | 41290 | 42600 |
| 31 | 36200 | 37430 | 38700 | 39960 | 41230 |
| 32 | 35070 | 36260 | 37490 | 38710 | 39940 |
| 33 | 34010 | 35160 | 36350 | 37540 | 38730 |
| 34 | 33010 | 34130 | 35280 | 36430 | 37590 |
| 35 | 32070 | 33150 | 34270 | 35390 | 36510 |
| 36 | 31170 | 32230 | 33320 | 34410 | 35500 |

*For safe loads* below the heavy lines, the deflections will be greate *than the allowable* limit for plastered ceilings = $\frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of beam.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 18 Inch No. B 65. | | | | 20 Inch No. B 73. | | |
| | 55 lbs. | 60 lbs. | 65 lbs. | 70 lbs. | 65 lbs. | 70 lbs. | 75 lbs. |
| 10 | 94290 | 99770 | 104470 | 109180 | 124750 | 130110 | 135340 |
| 11 | 85720 | 90700 | 94980 | 99250 | 113410 | 118280 | 123040 |
| 12 | 78570 | 83140 | 87060 | 90980 | 103960 | 108430 | 112780 |
| 13 | 72530 | 76740 | 80360 | 83980 | 95960 | 100090 | 104110 |
| 14 | 67350 | 71260 | 74620 | 77990 | 89110 | 92940 | 96670 |
| 15 | 62860 | 66510 | 69650 | 72790 | 83170 | 86740 | 90230 |
| 16 | 58930 | 62360 | 65300 | 68240 | 77970 | 81320 | 84590 |
| 17 | 55460 | 58650 | 61460 | 64220 | 73380 | 76540 | 79610 |
| 18 | 52380 | 55430 | 58040 | 60660 | 69310 | 72280 | 75190 |
| 19 | 49630 | 52510 | 54990 | 57460 | 65660 | 68480 | 71230 |
| 20 | 47140 | 49880 | 52240 | 54590 | 62370 | 65060 | 67670 |
| 21 | 44900 | 47510 | 49750 | 51990 | 59400 | 61960 | 64450 |
| 22 | 42860 | 45350 | 47490 | 49630 | 56700 | 59140 | 61520 |
| 23 | 40990 | 43380 | 45420 | 47470 | 54240 | 56570 | 58840 |
| 24 | 39290 | 41570 | 43530 | 45490 | 51980 | 54210 | 56390 |
| 25 | 37720 | 39910 | 41790 | 43670 | 49900 | 52040 | 54140 |
| 26 | 36260 | 38370 | 40180 | 41990 | 47980 | 50040 | 52050 |
| 27 | 34920 | 36950 | 38690 | 40440 | 46200 | 48190 | 50130 |
| 28 | 33670 | 35630 | 37310 | 38990 | 44550 | 46470 | 48340 |
| 29 | 32510 | 34400 | 36030 | 37650 | 43020 | 44870 | 46670 |
| 30 | 31430 | 33260 | 34820 | 36390 | 41580 | 43370 | 45110 |
| 31 | 30420 | 32180 | 33700 | 35220 | 40240 | 41970 | 43660 |
| 32 | 29460 | 31200 | 32650 | 34120 | 38980 | 40660 | 42290 |
| 33 | 28570 | 30230 | 31660 | 33080 | 37800 | 39430 | 41010 |
| 34 | 27730 | 29340 | 30730 | 32110 | 36690 | 38270 | 39810 |
| 35 | 26940 | 28510 | 29850 | 31190 | 35640 | 37170 | 38670 |
| 36 | 26190 | 27710 | 29020 | 30330 | 34650 | 36140 | 37590 |

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds pe square inch and include weight of beam.

| Distance between supports in feet. | STANDARD-SPECIAL I-BEAM. 20 Inch No. B 121. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 156410 | 160910 | 166140 | 171370 | 176600 |
| 11 | 142190 | 146280 | 151040 | 155790 | 160540 |
| 12 | 130340 | 134090 | 138450 | 142810 | 147160 |
| 13 | 120310 | 123780 | 127800 | 131820 | 135840 |
| 14 | 111720 | 114940 | 118670 | 122410 | 126140 |
| 15 | 104270 | 107270 | 110760 | 114250 | 117730 |
| 16 | 97750 | 100570 | 103840 | 107100 | 110370 |
| 17 | 92000 | 94650 | 97730 | 100800 | 103880 |
| 18 | 86890 | 89390 | 92300 | 95200 | 98110 |
| 19 | 82320 | 84690 | 87440 | 90190 | 92950 |
| 20 | 78200 | 80460 | 83070 | 85680 | 88300 |
| 21 | 74480 | 76620 | 79110 | 81600 | 84090 |
| 22 | 71090 | 73140 | 75520 | 77890 | 80270 |
| 23 | 68000 | 69960 | 72230 | 74510 | 76780 |
| 24 | 65170 | 67050 | 69220 | 71400 | 73580 |
| 25 | 62560 | 64360 | 66460 | 68550 | 70640 |
| 26 | 60160 | 61890 | 63900 | 65910 | 67920 |
| 27 | 57930 | 59600 | 61530 | 63470 | 65410 |
| 28 | 55860 | 57470 | 59340 | 61200 | 63070 |
| 29 | 53930 | 55490 | 57290 | 59090 | 60900 |
| 30 | 52140 | 53640 | 55380 | 57120 | 58870 |
| 31 | 50450 | 51910 | 53590 | 55280 | 56970 |
| 32 | 48880 | 50280 | 51920 | 53550 | 55190 |
| 33 | 47400 | 48760 | 50350 | 51930 | 53510 |
| 34 | 46000 | 47330 | 48860 | 50400 | 51940 |
| 35 | 44690 | 45970 | 47470 | 48960 | 50460 |
| 36 | 43450 | 44700 | 46150 | 47600 | 49050 |

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA I-BEAMS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of beam.

| Distance between supports in feet. | STANDARD I-BEAM. 24 Inch No. B 89. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 185530 | 192700 | 198970 | 205240 | 211520 |
| 11 | 168660 | 175180 | 180880 | 186590 | 192290 |
| 12 | 154610 | 160580 | 165810 | 171040 | 176270 |
| 13 | 142720 | 148230 | 153050 | 157880 | 162710 |
| 14 | 132520 | 137640 | 142120 | 146600 | 151080 |
| 15 | 123690 | 128460 | 132650 | 136830 | 141010 |
| 16 | 115960 | 120430 | 124360 | 128280 | 132200 |
| 17 | 109140 | 113350 | 117040 | 120730 | 124420 |
| 18 | 103070 | 107050 | 110540 | 114020 | 117510 |
| 19 | 97650 | 101420 | 104720 | 108020 | 111330 |
| 20 | 92770 | 96350 | 99480 | 102620 | 105760 |
| 21 | 88350 | 91760 | 94750 | 97740 | 100720 |
| 22 | 84330 | 87590 | 90440 | 93290 | 96140 |
| 23 | 80670 | 83780 | 86510 | 89240 | 91960 |
| 24 | 77300 | 80290 | 82900 | 85520 | 88130 |
| 25 | 74210 | 77080 | 79590 | 82100 | 84610 |
| 26 | 71360 | 74110 | 76530 | 78940 | 81350 |
| 27 | 68720 | 71370 | 73690 | 76020 | 78340 |
| 28 | 66260 | 68820 | 71060 | 73300 | 75540 |
| 29 | 63980 | 66450 | 68610 | 70770 | 72940 |
| 30 | 61840 | 64230 | 66320 | 68410 | 70510 |
| 31 | 59850 | 62160 | 64180 | 66210 | 68230 |
| 32 | 57980 | 60220 | 62180 | 64140 | 66100 |
| 33 | 56220 | 58390 | 60290 | 62200 | 64100 |
| 34 | 54570 | 56680 | 58520 | 60370 | 62210 |
| 35 | 53010 | 55060 | 56850 | 58640 | 60430 |
| 36 | 51540 | 53530 | 55270 | 57010 | 58760 |

Safe loads above dotted line are greater than safe loads for web crippling, *as shown on pages 66 to 68 inclusive.*

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA CHANNELS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of channel.

| Distance between supports in feet. | STANDARD CHANNELS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3 Inch No. C 5. | | | 4 Inch No. C 9. | | | 5 Inch No. C 13. | | |
| | 4 lbs. | 5 lbs. | 6 lbs. | 5.25 lbs. | 6.25 lbs. | 7.25 lbs. | 6.5 lbs. | 9 lbs. | 11.5 lbs. |
| 4 | 2910 | 3290 | 3680 | 5060 | 5570 | 6090 | 7910 | 9460 | 11100 |
| 5 | 2330 | 2630 | 2940 | 4050 | 4450 | 4870 | 6330 | 7570 | 8880 |
| 6 | 1940 | 2190 | 2450 | 3370 | 3710 | 4060 | 5270 | 6310 | 7400 |
| 7 | 1660 | 1880 | 2100 | 2890 | 3180 | 3480 | 4520 | 5410 | 6340 |
| 8 | 1450 | 1640 | 1840 | 2530 | 2780 | 3050 | 3960 | 4730 | 5550 |
| 9 | 1290 | 1460 | 1630 | 2250 | 2470 | 2510 | 3520 | 4210 | 4930 |
| 10 | 1160 | 1310 | 1470 | 2020 | 2230 | 2440 | 3160 | 3790 | 4440 |
| 11 | 1060 | 1190 | 1340 | 1840 | 2020 | 2210 | 2880 | 3440 | 4040 |
| 12 | 970 | 1100 | 1230 | 1690 | 1860 | 2030 | 2640 | 3150 | 3700 |
| 13 | 890 | 1010 | 1130 | 1560 | 1710 | 1870 | 2430 | 2910 | 3410 |
| 14 | 830 | 940 | 1050 | 1440 | 1590 | 1740 | 2260 | 2700 | 3170 |
| 15 | 780 | 880 | 980 | 1350 | 1480 | 1620 | 2110 | 2520 | 2960 |
| 16 | 730 | 820 | 920 | 1260 | 1390 | 1520 | 1980 | 2370 | 2770 |
| 17 | 680 | 770 | 870 | 1190 | 1310 | 1430 | 1860 | 2230 | 2610 |
| 18 | 650 | 730 | 820 | 1120 | 1240 | 1350 | 1760 | 2100 | 2470 |
| 19 | 610 | 690 | 770 | 1060 | 1170 | 1280 | 1670 | 1990 | 2340 |
| 20 | 580 | 660 | 740 | 1010 | 1110 | 1220 | 1580 | 1890 | 2220 |
| 21 | 550 | 630 | 700 | 960 | 1060 | 1160 | 1510 | 1800 | 2110 |
| 22 | 530 | 600 | 670 | 920 | 1010 | 1110 | 1440 | 1720 | 2020 |
| 23 | 510 | 570 | 640 | 880 | 970 | 1060 | 1380 | 1650 | 1930 |
| 24 | 480 | 550 | 610 | 840 | 930 | 1020 | 1320 | 1580 | 1850 |
| 25 | 470 | 530 | 590 | 810 | 890 | 970 | 1270 | 1510 | 1780 |

For safe loads below the heavy lines, the deflections will be greater than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA CHANNELS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of channel.

| Distance between supports in feet. | STANDARD CHANNELS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 6 Inch No. C 17. | | | | 7 Inch No. C 21. | | | | |
| | 8 lbs. | 10.5 lbs. | 13 lbs. | 15.5 lbs. | 9.75 lbs. | 12.25 lbs. | 14.75 lbs. | 17.25 lbs. | 19.75 lbs. |
| 4 | 11550 | 13440 | 15400 | 17360 | 16070 | 18410 | 20700 | 22990 | 25280 |
| 5 | 9240 | 10750 | 12320 | 13890 | 12850 | 14730 | 16560 | 18390 | 20220 |
| 6 | 7700 | 8960 | 10270 | 11570 | 10710 | 12280 | 13800 | 15330 | 16850 |
| 7 | 6600 | 7680 | 8800 | 9920 | 9180 | 10520 | 11830 | 13140 | 14440 |
| 8 | 5780 | 6720 | 7700 | 8680 | 8030 | 9210 | 10350 | 11490 | 12640 |
| 9 | 5130 | 5970 | 6840 | 7720 | 7140 | 8180 | 9200 | 10220 | 11230 |
| 10 | 4620 | 5380 | 6160 | 6940 | 6430 | 7370 | 8280 | 9200 | 10110 |
| 11 | 4200 | 4890 | 5600 | 6310 | 5840 | 6700 | 7530 | 8360 | 9190 |
| 12 | 3850 | 4480 | 5130 | 5790 | 5360 | 6140 | 6900 | 7660 | 8430 |
| 13 | 3550 | 4130 | 4740 | 5340 | 4940 | 5670 | 6370 | 7070 | 7780 |
| 14 | 3300 | 3840 | 4400 | 4960 | 4590 | 5260 | 5910 | 6570 | 7220 |
| 15 | 3080 | 3580 | 4110 | 4630 | 4280 | 4910 | 5520 | 6130 | 6740 |
| 16 | 2890 | 3360 | 3850 | 4340 | 4020 | 4600 | 5180 | 5750 | 6320 |
| 17 | 2720 | 3160 | 3620 | 4080 | 3780 | 4330 | 4870 | 5410 | 5950 |
| 18 | 2570 | 2990 | 3420 | 3860 | 3570 | 4090 | 4600 | 5110 | 5620 |
| 19 | 2430 | 2830 | 3240 | 3650 | 3380 | 3880 | 4360 | 4840 | 5320 |
| 20 | 2310 | 2690 | 3080 | 3470 | 3210 | 3680 | 4140 | 4600 | 5060 |
| 21 | 2200 | 2560 | 2930 | 3310 | 3060 | 3510 | 3940 | 4380 | 4810 |
| 22 | 2100 | 2440 | 2800 | 3160 | 2920 | 3350 | 3760 | 4180 | 4600 |
| 23 | 2010 | 2340 | 2680 | 3020 | 2790 | 3200 | 3600 | 4000 | 4400 |
| 24 | 1930 | 2240 | 2570 | 2890 | 2680 | 3070 | 3450 | 3830 | 4210 |
| 25 | 1850 | 2150 | 2460 | 2780 | 2570 | 2950 | 3310 | 3680 | 4040 |

For safe loads below the heavy lines, the deflections will be greater than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DIS TRIBUTED FOR CAMBRIA CHANNELS.

Safe loads below are figured for fibre stress of 16 000 pound square inch and include weight of channel.

| Distance between supports in feet. | STANDARD CHANNELS. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8 Inch No. C 25. | | | | | 9 Inch No. C 2 | | |
| | 11.25 lbs. | 13.75 lbs. | 16.25 lbs. | 18.75 lbs. | 21.25 lbs. | 13.25 lbs. | 15 lbs. | 20 lbs. |
| 4 | 21530 | 24000 | 26610 | 29230 | 31840 | 28040 | 30130 | 36020 |
| 5 | 17230 | 19200 | 21290 | 23380 | 25470 | 22430 | 24110 | 28810 |
| 6 | 14360 | 16000 | 17740 | 19480 | 21230 | 18690 | 20090 | 24010 |
| 7 | 12310 | 13710 | 15210 | 16700 | 18200 | 16020 | 17220 | 20580 |
| 8 | 10770 | 12000 | 13310 | 14610 | 15920 | 14020 | 15070 | 18010 |
| 9 | 9570 | 10670 | 11830 | 12990 | 14150 | 12460 | 13390 | 16010 |
| 10 | 8610 | 9600 | 10650 | 11690 | 12740 | 11220 | 12050 | 14410 |
| 11 | 7830 | 8730 | 9680 | 10630 | 11580 | 10200 | 10960 | 13100 |
| 12 | 7180 | 8000 | 8870 | 9740 | 10610 | 9350 | 10040 | 12010 |
| 13 | 6630 | 7380 | 8190 | 8990 | 9800 | 8630 | 9270 | 11080 |
| 14 | 6150 | 6860 | 7600 | 8350 | 9100 | 8010 | 8610 | 10290 |
| 15 | 5740 | 6400 | 7100 | 7790 | 8490 | 7480 | 8040 | 9600 |
| 16 | 5380 | 6000 | 6650 | 7310 | 7960 | 7010 | 7530 | 9000 |
| 17 | 5070 | 5650 | 6260 | 6880 | 7490 | 6600 | 7090 | 8470 |
| 18 | 4790 | 5330 | 5910 | 6490 | 7080 | 6230 | 6700 | 8000 |
| 19 | 4530 | 5050 | 5600 | 6150 | 6700 | 5900 | 6340 | 7580 |
| 20 | 4310 | 4800 | 5320 | 5850 | 6370 | 5610 | 6030 | 7200 |
| 21 | 4100 | 4570 | 5070 | 5570 | 6070 | 5340 | 5740 | 6860 |
| 22 | 3920 | 4360 | 4840 | 5310 | 5790 | 5100 | 5480 | 6550 |
| 23 | 3750 | 4170 | 4630 | 5080 | 5540 | 4880 | 5240 | 6260 |
| 24 | 3590 | 4000 | 4440 | 4870 | 5310 | 4670 | 5020 | 6000 |
| 25 | 3450 | 3840 | 4260 | 4680 | 5090 | 4490 | 4820 | 5760 |

For safe loads below the heavy lines, the deflections will be gr than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA CHANNELS.

Safe loads below are figured for fibre stress of 16 000 pounds per square inch and include weight of channel.

| Distance between supports in feet. | STANDARD CHANNEL. 10 Inch No. C 33. | | | | |
|---|---|---|---|---|---|
| | 15 lbs. | 20 lbs. | 25 lbs. | 30 lbs. | 35 lbs. |
| 10 | 14270 | 16790 | 19410 | 22020 | 24640 |
| 11 | 12970 | 15270 | 17640 | 20020 | 22400 |
| 12 | 11890 | 14000 | 16170 | 18350 | 20530 |
| 13 | 10980 | 12920 | 14930 | 16940 | 18950 |
| 14 | 10190 | 12000 | 13860 | 15730 | 17600 |
| 15 | 9510 | 11200 | 12940 | 14680 | 16430 |
| 16 | 8920 | 10500 | 12130 | 13760 | 15400 |
| 17 | 8390 | 9880 | 11420 | 12950 | 14490 |
| 18 | 7930 | 9330 | 10780 | 12240 | 13690 |
| 19 | 7510 | 8840 | 10220 | 11590 | 12970 |
| 20 | 7130 | 8400 | 9700 | 11010 | 12320 |
| 21 | 6790 | 8000 | 9240 | 10490 | 11730 |
| 22 | 6490 | 7630 | 8820 | 10010 | 11200 |
| 23 | 6200 | 7300 | 8440 | 9580 | 10710 |
| 24 | 5940 | 7000 | 8090 | 9180 | 10270 |
| 25 | 5710 | 6720 | 7760 | 8810 | 9860 |
| 26 | 5490 | 6460 | 7460 | 8470 | 9480 |
| 27 | 5280 | 6220 | 7190 | 8160 | 9130 |
| 28 | 5100 | 6000 | 6930 | 7870 | 8800 |
| 29 | 4920 | 5790 | 6690 | 7590 | 8500 |
| 30 | 4760 | 5600 | 6470 | 7340 | 8210 |

For safe loads below the heavy lines, the deflections will be greater than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

## SAFE LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA CHANNELS.

Safe loads below are figured for fibre stress of 16 000 pounds p square inch and include weight of channel.

| Distance between supports in feet. | STANDARD CHANNEL. 12 Inch No. C 41. | | | | |
|---|---|---|---|---|---|
| | 20.5 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 40 lbs. |
| 10 | 22780 | 25600 | 28740 | 31870 | 35010 |
| 11 | 20700 | 23270 | 26120 | 28980 | 31830 |
| 12 | 18980 | 21330 | 23950 | 26560 | 29180 |
| 13 | 17520 | 19690 | 22110 | 24520 | 26930 |
| 14 | 16270 | 18290 | 20530 | 22770 | 25010 |
| 15 | 15180 | 17070 | 19160 | 21250 | 23340 |
| 16 | 14230 | 16000 | 17960 | 19920 | 21880 |
| 17 | 13400 | 15060 | 16900 | 18750 | 20600 |
| 18 | 12650 | 14220 | 15970 | 17710 | 19450 |
| 19 | 11990 | 13470 | 15120 | 16780 | 18430 |
| 20 | 11390 | 12800 | 14370 | 15940 | 17510 |
| 21 | 10850 | 12190 | 13680 | 15180 | 16670 |
| 22 | 10350 | 11640 | 13060 | 14490 | 15910 |
| 23 | 9900 | 11130 | 12490 | 13860 | 15220 |
| 24 | 9490 | 10670 | 11970 | 13280 | 14590 |
| 25 | 9110 | 10240 | 11490 | 12750 | 14000 |
| 26 | 8760 | 9850 | 11050 | 12260 | 13470 |
| 27 | 8440 | 9480 | 10640 | 11810 | 12970 |
| 28 | 8130 | 9140 | 10260 | 11380 | 12500 |
| 29 | 7850 | 8830 | 9910 | 10990 | 12070 |
| 30 | 7590 | 8530 | 9580 | 10620 | 11670 |

For safe loads below the heavy lines, the deflections will be greate than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

## LOADS IN POUNDS UNIFORMLY DISTRIBUTED FOR CAMBRIA CHANNELS.

ds below are figured for fibre stress of 16 000 pounds per and include weight of channel.

### STANDARD CHANNEL.

#### 15 Inch No. C 53.

| 33 lbs. | 35 lbs. | 40 lbs. | 45 lbs. | 50 lbs. | 55 lbs. |
|---|---|---|---|---|---|
| 1450 | 45500 | 49420 | 53350 | 57270 | 61190 |
| 0410 | 41370 | 44930 | 48500 | 52060 | 55630 |
| 7040 | 37920 | 41190 | 44460 | 47720 | 50990 |
| 1190 | 35000 | 38020 | 41040 | 44050 | 47070 |
| 1750 | 32500 | 35300 | 38100 | 40910 | 43710 |
| 0630 | 30340 | 32950 | 35560 | 38180 | 40790 |
| 7780 | 28440 | 30890 | 33340 | 35790 | 38240 |
| 5150 | 26770 | 29070 | 31380 | 33690 | 35990 |
| 4700 | 25280 | 27460 | 29640 | 31820 | 33990 |
| 3400 | 23950 | 26010 | 28080 | 30140 | 32210 |
| 2230 | 22750 | 24710 | 26670 | 28630 | 30590 |
| 1170 | 21670 | 23540 | 25400 | 27270 | 29140 |
| 0210 | 20680 | 22470 | 24250 | 26030 | 27810 |
| 0330 | 19780 | 21490 | 23190 | 24900 | 26600 |
| 8520 | 18960 | 20590 | 22230 | 23860 | 25500 |
| 7780 | 18200 | 19770 | 21340 | 22910 | 24480 |
| 7100 | 17500 | 19010 | 20520 | 22030 | 23530 |
| 6460 | 16850 | 18310 | 19760 | 21210 | 22660 |
| 5880 | 16250 | 17650 | 19050 | 20450 | 21850 |
| 5330 | 15690 | 17040 | 18400 | 19750 | 21100 |
| 4820 | 15170 | 16470 | 17780 | 19090 | 20400 |

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.

Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 Inch No. B 5. | | | 4 Inch No. B 9. | | | |
| | 5.5 lbs. | 6.5 lbs. | 7.5 lbs. | 7.5 lbs. | 8.5 lbs. | 9.5 lbs. | 10.5 lbs. |
| 4 | 11.0 | 12.0 | 12.9 | 19.9 | 21.2 | 22.5 | 23.8 |
| 5 | 7.1 | 7.7 | 8.3 | 12.7 | 13.6 | 14.4 | 15.2 |
| 6 | 4.9 | 5.3 | 5.8 | 8.8 | 9.4 | 10.0 | 10.6 |
| 7 | 3.6 | 3.9 | 4.2 | 6.5 | 6.9 | 7.3 | 7.8 |
| 8 | 2.8 | 3.0 | 3.2 | 5.0 | 5.3 | 5.6 | 5.9 |
| 9 | 2.2 | 2.4 | 2.6 | 3.9 | 4.2 | 4.4 | 4.7 |
| 10 | 1.8 | 1.9 | 2.1 | 3.2 | 3.4 | 3.6 | 3.8 |
| 11 | 1.5 | 1.6 | 1.7 | 2.6 | 2.8 | 3.0 | 3.1 |
| 12 | 1.2 | 1.3 | 1.4 | 2.2 | 2.4 | 2.5 | 2.6 |
| 13 | 1.0 | 1.1 | 1.2 | 1.9 | 2.0 | 2.1 | 2.3 |
| 14 | .... | 1.0 | 1.1 | 1.6 | 1.7 | 1.8 | 1.9 |
| 15 | .... | .... | .... | 1.4 | 1.5 | 1.6 | 1.7 |
| 16 | .... | .... | .... | 1.2 | 1.3 | 1.4 | 1.5 |
| 17 | .... | .... | .... | 1.1 | 1.2 | 1.2 | 1.3 |
| 18 | .... | .... | .... | 1.0 | 1.0 | 1.1 | 1.2 |
| 19 | .... | .... | .... | .... | .... | 1.0 | 1.1 |
| 20 | .... | .... | .... | .... | .... | .... | 1.0 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | |
|---|---|---|---|---|---|---|
| | 5 Inch No. B 13. | | | 6 Inch No. B 17. | | |
| | 9.75 lbs. | 12.25 lbs. | 14.75 lbs. | 12.25 lbs. | 14.75 lbs. | 17.25 lbs. |
| 4 | 32.2 | 36.3 | 40.4 | 48.4 | 53.3 | 58.2 |
| 5 | 20.6 | 23.2 | 25.9 | 31.0 | 34.1 | 37.2 |
| 6 | 14.3 | 16.1 | 18.0 | 21.5 | 23.7 | 25.9 |
| 7 | 10.5 | 11.9 | 13.2 | 15.8 | 17.4 | 19.0 |
| 8 | 8.1 | 9.1 | 10.1 | 12.1 | 13.3 | 14.5 |
| 9 | 6.4 | 7.2 | 8.0 | 9.6 | 10.5 | 11.5 |
| 10 | 5.2 | 5.8 | 6.5 | 7.7 | 8.5 | 9.3 |
| 11 | 4.3 | 4.8 | 5.3 | 6.4 | 7.0 | 7.7 |
| 12 | 3.6 | 4.0 | 4.5 | 5.4 | 5.9 | 6.5 |
| 13 | 3.1 | 3.4 | 3.8 | 4.6 | 5.0 | 5.5 |
| 14 | 2.6 | 3.0 | 3.3 | 4.0 | 4.4 | 4.8 |
| 15 | 2.3 | 2.6 | 2.9 | 3.4 | 3.8 | 4.1 |
| 16 | 2.0 | 2.3 | 2.5 | 3.0 | 3.3 | 3.6 |
| 17 | 1.8 | 2.0 | 2.2 | 2.7 | 3.0 | 3.2 |
| 18 | 1.6 | 1.8 | 2.0 | 2.4 | 2.6 | 2.9 |
| 19 | 1.4 | 1.6 | 1.8 | 2.1 | 2.4 | 2.6 |
| 20 | 1.3 | 1.5 | 1.6 | 1.9 | 2.1 | 2.3 |
| 21 | 1.2 | 1.3 | 1.5 | 1.8 | 1.9 | 2.1 |
| 22 | 1.1 | 1.2 | 1.3 | 1.6 | 1.8 | 1.9 |
| 23 | 1.0 | 1.1 | 1.2 | 1.5 | 1.6 | 1.8 |
| 24 | .... | 1.0 | 1.1 | 1.3 | 1.5 | 1.6 |
| 25 | .... | .... | 1.0 | 1.2 | 1.4 | 1.5 |
| 26 | .... | .... | 1.0 | 1.1 | 1.3 | 1.4 |
| 27 | .... | .... | .... | 1.1 | 1.2 | 1.3 |
| 28 | .... | .... | .... | 1.0 | 1.1 | 1.2 |
| 29 | .... | .... | .... | .... | 1.0 | 1.1 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required } \textit{spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 7 Inch No. B 21. | | | 8 Inch No. B 25. | | | |
| | 15 lbs. | 17.5 lbs. | 20 lbs. | 18.00 lbs. | 20.25 lbs. | 22.75 lbs. | 25.25 lbs. |
| 4 | 69.0 | 74.6 | 80.3 | 94.8 | 100.3 | 106.9 | 113.4 |
| 5 | 44.2 | 47.8 | 51.4 | 60.7 | 64.2 | 68.4 | 72.6 |
| 6 | 30.7 | 33.2 | 35.7 | 42.1 | 44.6 | 47.5 | 50.4 |
| 7 | 22.5 | 24.4 | 26.2 | 31.0 | 32.8 | 34.9 | 37.0 |
| 8 | 17.3 | 18.7 | 20.1 | 23.7 | 25.1 | 26.7 | 28.3 |
| 9 | 13.6 | 14.7 | 15.9 | 18.7 | 19.8 | 21.1 | 22.4 |
| 10 | 11.0 | 11.9 | 12.9 | 15.2 | 16.1 | 17.1 | 18.1 |
| 11 | 9.1 | 9.9 | 10.6 | 12.5 | 13.3 | 14.1 | 15.0 |
| 12 | 7.7 | 8.3 | 8.9 | 10.5 | 11.1 | 11.9 | 12.6 |
| 13 | 6.5 | 7.1 | 7.6 | 9.0 | 9.5 | 10.1 | 10.7 |
| 14 | 5.6 | 6.1 | 6.6 | 7.7 | 8.2 | 8.7 | 9.3 |
| 15 | 4.9 | 5.3 | 5.7 | 6.7 | 7.1 | 7.6 | 8.1 |
| 16 | 4.3 | 4.7 | 5.0 | 5.9 | 6.3 | 6.7 | 7.1 |
| 17 | 3.8 | 4.1 | 4.4 | 5.2 | 5.6 | 5.9 | 6.3 |
| 18 | 3.4 | 3.7 | 4.0 | 4.7 | 5.0 | 5.3 | 5.6 |
| 19 | 3.1 | 3.3 | 3.6 | 4.2 | 4.4 | 4.7 | 5.0 |
| 20 | 2.8 | 3.0 | 3.2 | 3.8 | 4.0 | 4.3 | 4.5 |
| 21 | 2.5 | 2.7 | 2.9 | 3.4 | 3.6 | 3.9 | 4.1 |
| 22 | 2.3 | 2.5 | 2.7 | 3.1 | 3.3 | 3.5 | 3.7 |
| 23 | 2.1 | 2.3 | 2.4 | 2.9 | 3.0 | 3.2 | 3.4 |
| 24 | 1.9 | 2.1 | 2.2 | 2.6 | 2.8 | 3.0 | 3.1 |
| 25 | 1.8 | 1.9 | 2.1 | 2.4 | 2.6 | 2.7 | 2.9 |
| 26 | 1.6 | 1.8 | 1.9 | 2.2 | 2.4 | 2.5 | 2.7 |
| 27 | 1.5 | 1.6 | 1.8 | 2.1 | 2.2 | 2.3 | 2.5 |
| 28 | 1.4 | 1.5 | 1.6 | 1.9 | 2.0 | 2.2 | 2.3 |
| 29 | 1.3 | 1.4 | 1.5 | 1.8 | 1.9 | 2.0 | 2.2 |

For spacings above the dotted lines the safe loads for bending are greater than the safe loads for web crippling, as explained on pages 66 to 68 inclusive.

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

*Spacings for* other intensities of loading may be obtained from those in tables as *follows:*

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \textit{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 9 Inch No. B 29. | | | | 10 Inch No. B 33. | | | |
| | 21 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 40 lbs. |
| 8 | 31.5 | 34.1 | 37.7 | 41.4 | .... | .... | .... | .... |
| 9 | 24.9 | 26.9 | 29.8 | 32.7 | .... | .... | .... | .... |
| 10 | 20.1 | 21.8 | 24.1 | 26.5 | 26.0 | 28.6 | 31.2 | 33.9 |
| 11 | 16.6 | 18.0 | 20.0 | 21.9 | 21.5 | 23.7 | 25.8 | 28.0 |
| 12 | 14.0 | 15.1 | 16.8 | 18.4 | 18.1 | 19.9 | 21.7 | 23.5 |
| 13 | 11.9 | 12.9 | 14.3 | 15.7 | 15.4 | 16.9 | 18.5 | 20.0 |
| 14 | 10.3 | 11.1 | 12.3 | 13.5 | 13.3 | 14.6 | 15.9 | 17.3 |
| 15 | 8.9 | 9.7 | 10.7 | 11.8 | 11.6 | 12.7 | 13.9 | 15.0 |
| 16 | 7.9 | 8.5 | 9.4 | 10.4 | 10.2 | 11.2 | 12.2 | 13.2 |
| 17 | 7.0 | 7.5 | 8.4 | 9.2 | 9.0 | 9.9 | 10.8 | 11.7 |
| 18 | 6.2 | 6.7 | 7.5 | 8.2 | 8.0 | 8.8 | 9.6 | 10.4 |
| 19 | 5.6 | 6.0 | 6.7 | 7.3 | 7.2 | 7.9 | 8.7 | 9.4 |
| 20 | 5.0 | 5.4 | 6.0 | 6.6 | 6.5 | 7.2 | 7.8 | 8.5 |
| 21 | 4.6 | 4.9 | 5.5 | 6.0 | 5.9 | 6.5 | 7.1 | 7.7 |
| 22 | 4.2 | 4.5 | 5.0 | 5.5 | 5.4 | 5.9 | 6.5 | 7.0 |
| 23 | 3.8 | 4.1 | 4.6 | 5.0 | 4.9 | 5.4 | 5.9 | 6.4 |
| 24 | 3.5 | 3.8 | 4.2 | 4.6 | 4.5 | 5.0 | 5.4 | 5.9 |
| 25 | 3.2 | 3.5 | 3.9 | 4.2 | 4.2 | 4.6 | 5.0 | 5.4 |
| 26 | 3.0 | 3.2 | 3.6 | 3.9 | 3.9 | 4.2 | 4.6 | 5.0 |
| 27 | 2.8 | 3.0 | 3.3 | 3.6 | 3.6 | 3.9 | 4.3 | 4.6 |
| 28 | 2.6 | 2.8 | 3.1 | 3.4 | 3.3 | 3.7 | 4.0 | 4.3 |
| 29 | 2.4 | 2.6 | 2.9 | 3.2 | 3.1 | 3.4 | 3.7 | 4.0 |
| 30 | 2.2 | 2.4 | 2.7 | 2.9 | 2.9 | 3.2 | 3.5 | 3.8 |
| 31 | 2.1 | 2.3 | 2.5 | 2.8 | 2.7 | 3.0 | 3.3 | 3.5 |
| 32 | .... | .... | .... | .... | 2.5 | 2.8 | 3.1 | 3.3 |
| 33 | .... | .... | .... | .... | 2.4 | 2.6 | 2.9 | 3.1 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 12 Inch No. B 41. | | | SPECIAL I-BEAM. 12 Inch No. B 105. | | |
|---|---|---|---|---|---|---|
| | 31.5 lbs. | 35 lbs. | 40 lbs. | 40 lbs. | 45 lbs. | 50 lbs. |
| 10 | 38.4 | 40.6 | 43.7 | 47.8 | 50.8 | 53.9 |
| 11 | 31.7 | 33.5 | 36.1 | 39.5 | 42.0 | 44.6 |
| 12 | 26.6 | 28.2 | 30.4 | 33.2 | 35.3 | 37.5 |
| 13 | 22.7 | 24.0 | 25.9 | 28.3 | 30.1 | 31.9 |
| 14 | 19.6 | 20.7 | 22.3 | 24.4 | 25.9 | 27.5 |
| 15 | 17.1 | 18.0 | 19.4 | 21.3 | 22.6 | 24.0 |
| 16 | 15.0 | 15.9 | 17.1 | 18.7 | 19.8 | 21.1 |
| 17 | 13.3 | 14.0 | 15.1 | 16.5 | 17.6 | 18.7 |
| 18 | 11.8 | 12.5 | 13.5 | 14.8 | 15.7 | 16.6 |
| 19 | 10.6 | 11.2 | 12.1 | 13.2 | 14.1 | 14.9 |
| 20 | 9.6 | 10.1 | 10.9 | 12.0 | 12.7 | 13.5 |
| 21 | 8.7 | 9.2 | 9.9 | 10.8 | 11.5 | 12.2 |
| 22 | 7.9 | 8.4 | 9.0 | 9.9 | 10.5 | 11.1 |
| 23 | 7.3 | 7.7 | 8.3 | 9.0 | 9.6 | 10.2 |
| 24 | 6.7 | 7.0 | 7.6 | 8.3 | 8.8 | 9.4 |
| 25 | 6.1 | 6.5 | 7.0 | 7.7 | 8.1 | 8.6 |
| 26 | 5.7 | 6.0 | 6.5 | 7.1 | 7.5 | 8.0 |
| 27 | 5.3 | 5.6 | 6.0 | 6.6 | 7.0 | 7.4 |
| 28 | 4.9 | 5.2 | 5.6 | 6.1 | 6.5 | 6.9 |
| 29 | 4.6 | 4.8 | 5.2 | 5.7 | 6.0 | 6.4 |
| 30 | 4.3 | 4.5 | 4.9 | 5.3 | 5.6 | 6.0 |
| 31 | 4.0 | 4.2 | 4.5 | 5.0 | 5.3 | 5.6 |
| 32 | 3.7 | 4.0 | 4.3 | 4.7 | 5.0 | 5.3 |
| 33 | 3.5 | 3.7 | 4.0 | 4.4 | 4.7 | 5.0 |
| 34 | 3.3 | 3.5 | 3.8 | 4.1 | 4.4 | 4.7 |
| 35 | 3.1 | 3.3 | 3.6 | 3.9 | 4.1 | 4.4 |
| 36 | 3.0 | 3.1 | 3.4 | 3.7 | 3.9 | 4.2 |

For spacings below the heavy lines the deflections will be greater than allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing}$$

## SPACING OF CAMBRIA I-BEAMS FOR U FORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 15 Inch No. B 109. | | | | |
|---|---|---|---|---|---|
| | 60 lbs. | 65 lbs. | 70 lbs. | 75 lbs. | 8 lb |
| 10 | 86.6 | 90.5 | 94.4 | 98.3 | 10 |
| 11 | 71.6 | 74.8 | 78.0 | 81.2 | 8 |
| 12 | 60.1 | 62.8 | 65.5 | 68.3 | 7 |
| 13 | 51.3 | 53.5 | 55.9 | 58.2 | 6 |
| 14 | 44.2 | 46.2 | 48.2 | 50.2 | 5 |
| 15 | 38.5 | 40.2 | 41.9 | 43.7 | 4 |
| 16 | 33.8 | 35.3 | 36.9 | 38.4 | 3 |
| 17 | 30.0 | 31.3 | 32.7 | 34.0 | 3 |
| 18 | 26.7 | 27.9 | 29.1 | 30.3 | 3 |
| 19 | 24.0 | 25.1 | 26.1 | 27.2 | 2 |
| 20 | 21.7 | 22.6 | 23.6 | 24.6 | 2 |
| 21 | 19.6 | 20.5 | 21.4 | 22.3 | 2 |
| 22 | 17.9 | 18.7 | 19.5 | 20.3 | 2 |
| 23 | 16.4 | 17.1 | 17.8 | 18.6 | 1 |
| 24 | 15.0 | 15.7 | 16.4 | 17.1 | 1 |
| 25 | 13.9 | 14.5 | 15.1 | 15.7 | 1 |
| 26 | 12.8 | 13.4 | 14.0 | 14.5 | 1 |
| 27 | 11.9 | 12.4 | 12.9 | 13.5 | 1 |
| 28 | 11.0 | 11.5 | 12.0 | 12.5 | 1 |
| 29 | 10.3 | 10.8 | 11.2 | 11.7 | 1 |
| 30 | 9.6 | 10.1 | 10.5 | 10.9 | 1 |
| 31 | 9.0 | 9.4 | 9.8 | 10.2 | 1 |
| 32 | 8.5 | 8.8 | 9.2 | 9.6 | 1 |
| 33 | 8.0 | 8.3 | 8.7 | 9.0 | |
| 34 | 7.5 | 7.8 | 8.2 | 8.5 | |
| 35 | 7.1 | 7.4 | 7.7 | 8.0 | |
| 36 | 6.7 | 7.0 | 7.3 | 7.6 | |

For spacings below the heavy lines the deflections will be greater th
allowable limit for plastered ceilings = $\frac{1}{360}$ span.
Spacings for other intensities of loading may be obtained from those in t
*follows:*

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing fro}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 15 Inch No. B 113. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 112.2 | 116.0 | 120.0 | 123.9 | 127.8 |
| 11 | 92.8 | 95.9 | 99.1 | 102.4 | 105.6 |
| 12 | 77.9 | 80.6 | 83.3 | 86.0 | 88.7 |
| 13 | 66.4 | 68.7 | 71.0 | 73.3 | 75.6 |
| 14 | 57.3 | 59.2 | 61.2 | 63.2 | 65.2 |
| 15 | 49.9 | 51.6 | 53.3 | 55.1 | 56.8 |
| 16 | 43.8 | 45.3 | 46.9 | 48.4 | 49.9 |
| 17 | 38.8 | 40.2 | 41.5 | 42.9 | 44.2 |
| 18 | 34.6 | 35.8 | 37.0 | 38.2 | 39.4 |
| 19 | 31.1 | 32.1 | 33.2 | 34.3 | 35.4 |
| 20 | 28.1 | 29.0 | 30.0 | 31.0 | 31.9 |
| 21 | 25.4 | 26.3 | 27.2 | 28.1 | 29.0 |
| 22 | 23.2 | 24.0 | 24.8 | 25.6 | 26.4 |
| 23 | 21.2 | 21.9 | 22.7 | 23.4 | 24.2 |
| 24 | 19.5 | 20.1 | 20.8 | 21.5 | 22.2 |
| 25 | 18.0 | 18.6 | 19.2 | 19.8 | 20.4 |
| 26 | 16.6 | 17.2 | 17.7 | 18.3 | 18.9 |
| 27 | 15.4 | 15.9 | 16.5 | 17.0 | 17.5 |
| 28 | 14.3 | 14.8 | 15.3 | 15.8 | 16.3 |
| 29 | 13.3 | 13.8 | 14.3 | 14.7 | 15.2 |
| 30 | 12.5 | 12.9 | 13.3 | 13.8 | 14.2 |
| 31 | 11.7 | 12.1 | 12.5 | 12.9 | 13.3 |
| 32 | 11.0 | 11.3 | 11.7 | 12.1 | 12.5 |
| 33 | 10.3 | 10.7 | 11.0 | 11.4 | 11.7 |
| 34 | 9.7 | 10.0 | 10.4 | 10.7 | 11.1 |
| 35 | 9.2 | 9.5 | 9.8 | 10.1 | 10.4 |
| 36 | 8.7 | 9.0 | 9.3 | 9.6 | 9.9 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required } \textit{spacing} = \frac{\text{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR U
## FORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 18 Inch No. B 65. | | | | 20 Inch No. B | | |
| | 55 lbs. | 60 lbs. | 65 lbs. | 70 lbs. | 65 lbs. | 70 lbs. | |
| 10 | 94.3 | 99.8 | 104.5 | 109.2 | 124.7 | 130.1 | 1 |
| 11 | 77.9 | 82.5 | 86.3 | 90.2 | 103.1 | 107.5 | 1 |
| 12 | 65.5 | 69.3 | 72.6 | 75.8 | 86.6 | 90.4 | |
| 13 | 55.8 | 59.0 | 61.8 | 64.6 | 73.8 | 77.0 | |
| 14 | 48.1 | 50.9 | 53.3 | 55.7 | 63.6 | 66.4 | |
| 15 | 41.9 | 44.3 | 46.4 | 48.5 | 55.4 | 57.8 | |
| 16 | 36.8 | 39.0 | 40.8 | 42.6 | 48.7 | 50.8 | |
| 17 | 32.6 | 34.5 | 36.2 | 37.8 | 43.2 | 45.0 | |
| 18 | 29.1 | 30.8 | 32.2 | 33.7 | 38.5 | 40.2 | |
| 19 | 26.1 | 27.6 | 28.9 | 30.2 | 34.6 | 36.0 | |
| 20 | 23.6 | 24.9 | 26.1 | 27.3 | 31.2 | 32.5 | |
| 21 | 21.4 | 22.6 | 23.7 | 24.8 | 28.3 | 29.5 | |
| 22 | 19.5 | 20.6 | 21.6 | 22.6 | 25.8 | 26.9 | |
| 23 | 17.8 | 18.9 | 19.7 | 20.6 | 23.6 | 24.6 | |
| 24 | 16.4 | 17.3 | 18.1 | 19.0 | 21.7 | 22.6 | |
| 25 | 15.1 | 16.0 | 16.7 | 17.5 | 20.0 | 20.8 | |
| 26 | 13.9 | 14.8 | 15.5 | 16.2 | 18.5 | 19.2 | |
| 27 | 12.9 | 13.7 | 14.3 | 15.0 | 17.1 | 17.8 | |
| 28 | 12.0 | 12.7 | 13.3 | 13.9 | 15.9 | 16.6 | |
| 29 | 11.2 | 11.9 | 12.4 | 13.0 | 14.8 | 15.5 | |
| 30 | 10.5 | 11.1 | 11.6 | 12.1 | 13.9 | 14.5 | |
| 31 | 9.8 | 10.4 | 10.9 | 11.4 | 13.0 | 13.5 | |
| 32 | 9.2 | 9.7 | 10.2 | 10.7 | 12.2 | 12.7 | |
| 33 | 8.7 | 9.2 | 9.6 | 10.0 | 11.5 | 11.9 | |
| 34 | 8.2 | 8.6 | 9.0 | 9.4 | 10.8 | 11.3 | |
| 35 | 7.7 | 8.1 | 8.5 | 8.9 | 10.2 | 10.6 | |
| 36 | 7.3 | 7.7 | 8.1 | 8.4 | 9.6 | 10.0 | |

Spacings for other intensities of loading may be obtained from those in ta
follows:

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 20 Inch No. B 121. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 156.4 | 160.9 | 166.1 | 171.4 | 176.6 |
| 11 | 129.3 | 133.0 | 137.3 | 141.6 | 145.9 |
| 12 | 108.6 | 111.7 | 115.4 | 119.0 | 122.6 |
| 13 | 92.5 | 95.2 | 98.3 | 101.4 | 104.5 |
| 14 | 79.8 | 82.1 | 84.8 | 87.4 | 90.1 |
| 15 | 69.5 | 71.5 | 73.8 | 76.2 | 78.5 |
| 16 | 61.1 | 62.9 | 64.9 | 66.9 | 69.0 |
| 17 | 54.1 | 55.7 | 57.5 | 59.3 | 61.1 |
| 18 | 48.3 | 49.7 | 51.3 | 52.9 | 54.5 |
| 19 | 43.3 | 44.6 | 46.0 | 47.5 | 48.9 |
| 20 | 39.1 | 40.2 | 41.5 | 42.8 | 44.1 |
| 21 | 35.5 | 36.5 | 37.7 | 38.9 | 40.0 |
| 22 | 32.3 | 33.2 | 34.3 | 35.4 | 36.5 |
| 23 | 29.6 | 30.4 | 31.4 | 32.4 | 33.4 |
| 24 | 27.2 | 27.9 | 28.8 | 29.8 | 30.7 |
| 25 | 25.0 | 25.7 | 26.6 | 27.4 | 28.3 |
| 26 | 23.1 | 23.8 | 24.6 | 25.4 | 26.1 |
| 27 | 21.5 | 22.1 | 22.8 | 23.5 | 24.2 |
| 28 | 19.9 | 20.5 | 21.2 | 21.9 | 22.5 |
| 29 | 18.6 | 19.1 | 19.8 | 20.4 | 21.0 |
| 30 | 17.4 | 17.9 | 18.5 | 19.0 | 19.6 |
| 31 | 16.3 | 16.7 | 17.3 | 17.8 | 18.4 |
| 32 | 15.3 | 15.7 | 16.2 | 16.7 | 17.2 |
| 33 | 14.4 | 14.8 | 15.3 | 15.7 | 16.2 |
| 34 | 13.5 | 13.9 | 14.4 | 14.8 | 15.3 |
| 35 | 12.8 | 13.1 | 13.6 | 14.0 | 14.4 |
| 36 | 12.1 | 12.4 | 12.8 | 13.2 | 13.6 |

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR FORM LOAD OF 100 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 24 Inch No. B 89. | | | |
|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. |
| 10 | 185.5 | 192.7 | 199.0 | 205.2 |
| 11 | 153.3 | 159.3 | 164.4 | 169.6 |
| 12 | 128.8 | 133.8 | 138.2 | 142.5 |
| 13 | 109.8 | 114.0 | 117.7 | 121.4 |
| 14 | 94.7 | 98.3 | 101.5 | 104.7 |
| 15 | 82.5 | 85.6 | 88.4 | 91.2 |
| 16 | 72.5 | 75.3 | 77.7 | 80.2 |
| 17 | 64.2 | 66.7 | 68.8 | 71.0 |
| 18 | 57.3 | 59.5 | 61.4 | 63.3 |
| 19 | 51.4 | 53.4 | 55.1 | 56.9 |
| 20 | 46.4 | 48.2 | 49.7 | 51.3 |
| 21 | 42.1 | 43.7 | 45.1 | 46.5 |
| 22 | 38.3 | 39.8 | 41.1 | 42.4 |
| 23 | 35.1 | 36.4 | 37.6 | 38.8 |
| 24 | 32.2 | 33.5 | 34.5 | 35.6 |
| 25 | 29.7 | 30.8 | 31.8 | 32.8 |
| 26 | 27.4 | 28.5 | 29.4 | 30.4 |
| 27 | 25.5 | 26.4 | 27.3 | 28.2 |
| 28 | 23.7 | 24.6 | 25.4 | 26.2 |
| 29 | 22.1 | 22.9 | 23.7 | 24.4 |
| 30 | 20.6 | 21.4 | 22.1 | 22.8 |
| 31 | 19.3 | 20.1 | 20.7 | 21.4 |
| 32 | 18.1 | 18.8 | 19.4 | 20.0 |
| 33 | 17.0 | 17.7 | 18.3 | 18.8 |
| 34 | 16.0 | 16.7 | 17.2 | 17.8 |
| 35 | 15.1 | 15.7 | 16.2 | 16.8 |
| 36 | 14.3 | 14.9 | 15.4 | 15.8 |

For spacings above the dotted lines the safe loads for bending are gre
the safe loads for web crippling, as explained on pages 66 to 68 inclusive.

Spacings for other intensities of loading may be obtained from those in
*follows:*

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing f}$$

## ACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|
| 3 Inch No. B. 5. | | | 4 Inch No. B 9. | | | |
| 5.5 lbs. | 6.5 lbs. | 7.5 lbs. | 7.5 lbs. | 8.5 lbs. | 9.5 lbs. | 10.5 lbs. |
| 8.8 | 9.6 | 10.4 | 15.9 | 16.9 | 18.0 | 19.0 |
| 5.6 | 6.1 | 6.6 | 10.2 | 10.8 | 11.5 | 12.2 |
| 3.9 | 4.3 | 4.6 | 7.1 | 7.5 | 8.0 | 8.5 |
| 2.9 | 3.1 | 3.4 | 5.2 | 5.5 | 5.9 | 6.2 |
| 2.2 | 2.4 | 2.6 | 4.0 | 4.2 | 4.5 | 4.8 |
| 1.7 | 1.9 | 2.0 | 3.1 | 3.3 | 3.6 | 3.8 |
| 1.4 | 1.5 | 1.7 | 2.5 | 2.7 | 2.9 | 3.0 |
| 1.2 | 1.3 | 1.4 | 2.1 | 2.2 | 2.4 | 2.5 |
| 1.0 | 1.1 | 1.2 | 1.8 | 1.9 | 2.0 | 2.1 |
| .... | .... | 1.0 | 1.5 | 1.6 | 1.7 | 1.8 |
| .... | .... | .... | 1.3 | 1.4 | 1.5 | 1.6 |
| .... | .... | .... | 1.1 | 1.2 | 1.3 | 1.4 |
| .... | .... | .... | 1.0 | 1.1 | 1.1 | 1.2 |
| .... | .... | .... | .... | .... | 1.0 | 1.1 |

or spacings below the heavy lines the deflections will be greater than the ible limit for plastered ceilings = $\frac{1}{360}$ span.

pacings for other intensities of loading may be obtained from those in tables as s:

ired spacing = $\frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times$ Computed spacing from table.

## SPACING OF CAMBRIA I BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | |
|---|---|---|---|---|---|---|
| | 5 Inch No. B 13. | | | 6 Inch No. B 17. | | |
| | 9.75 lbs. | 12.25 lbs. | 14.75 lbs. | 12.25 lbs. | 14.75 lbs. | 17 lbs. |
| 4 | 25.8 | 29.0 | 32.3 | 38.7 | 42.6 | 4 |
| 5 | 16.5 | 18.6 | 20.7 | 24.8 | 27.3 | 2 |
| 6 | 11.5 | 12.9 | 14.4 | 17.2 | 18.9 | 2 |
| 7 | 8.4 | 9.5 | 10.6 | 12.6 | 13.9 | 1 |
| 8 | 6.4 | 7.3 | 8.1 | 9.7 | 10.7 | 1 |
| 9 | 5.1 | 5.7 | 6.4 | 7.7 | 8.4 | |
| 10 | 4.1 | 4.6 | 5.2 | 6.2 | 6.8 | |
| 11 | 3.4 | 3.8 | 4.3 | 5.1 | 5.6 | |
| 12 | 2.9 | 3.2 | 3.6 | 4.3 | 4.7 | |
| 13 | 2.4 | 2.8 | 3.1 | 3.7 | 4.0 | |
| 14 | 2.1 | 2.4 | 2.6 | 3.2 | 3.5 | |
| 15 | 1.8 | 2.1 | 2.3 | 2.8 | 3.0 | |
| 16 | 1.6 | 1.8 | 2.0 | 2.4 | 2.7 | |
| 17 | 1.4 | 1.6 | 1.8 | 2.1 | 2.4 | |
| 18 | 1.3 | 1.4 | 1.6 | 1.9 | 2.1 | |
| 19 | 1.1 | 1.3 | 1.4 | 1.7 | 1.9 | |
| 20 | 1.0 | 1.2 | 1.3 | 1.5 | 1.7 | |
| 21 | .... | 1.1 | 1.2 | 1.4 | 1.5 | |
| 22 | .... | 1.0 | 1.1 | 1.3 | 1.4 | |
| 23 | .... | .... | 1.0 | 1.2 | 1.3 | |
| 24 | .... | .... | .... | 1.1 | 1.2 | |
| 25 | .... | .... | .... | 1.0 | 1.1 | |
| 26 | .... | .... | .... | .... | 1.0 | |
| 27 | .... | .... | .... | .... | .... | |
| 28 | .... | .... | .... | .... | .... | |

For spacings below the heavy lines the deflections will be greater than allowable limit for plastered ceilings = $\frac{1}{360}$ span.

*Spacings* for other intensities of loading may be obtained from those in table as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table}$$

# SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|
| 7 Inch No. B 21. | | | 8 Inch No. B 25. | | | |
| 15 lbs. | 17.5 lbs. | 20 lbs. | 18.00 lbs. | 20.25 lbs. | 22.75 lbs. | 25.25 lbs. |
| 55.2 | 59.7 | 64.3 | 75.8 | 80.3 | 85.5 | 90.7 |
| 35.5 | 38.2 | 41.1 | 48.5 | 51.4 | 54.7 | 58.1 |
| 24.5 | 26.5 | 28.6 | 33.7 | 35.7 | 38.0 | 40.3 |
| 18.0 | 19.5 | 21.0 | 24.8 | 26.2 | 27.9 | 29.6 |
| 13.8 | 13.9 | 16.1 | 19.0 | 20.1 | 21.4 | 22.7 |
| 10.9 | 11.8 | 12.7 | 15.0 | 15.9 | 16.9 | 17.9 |
| 8.8 | 9.5 | 10.3 | 12.1 | 12.8 | 13.7 | 14.5 |
| 7.3 | 7.9 | 8.5 | 10.0 | 10.6 | 11.3 | 12.0 |
| 6.1 | 6.6 | 7.1 | 8.4 | 8.9 | 9.5 | 10.1 |
| 5.2 | 5.7 | 6.1 | 7.2 | 7.6 | 8.1 | 8.6 |
| 4.5 | 4.9 | 5.2 | 6.2 | 6.6 | 7.0 | 7.4 |
| 3.9 | 4.2 | 4.6 | 5.4 | 5.7 | 6.1 | 6.5 |
| 3.5 | 3.7 | 4.0 | 4.7 | 5.0 | 5.3 | 5.7 |
| 3.1 | 3.3 | 3.6 | 4.2 | 4.4 | 4.7 | 5.0 |
| 2.7 | 2.9 | 3.2 | 3.7 | 4.0 | 4.2 | 4.5 |
| 2.4 | 2.6 | 2.8 | 3.4 | 3.6 | 3.8 | 4.0 |
| 2.2 | 2.4 | 2.6 | 3.0 | 3.2 | 3.4 | 3.6 |
| 2.0 | 2.2 | 2.3 | 2.8 | 2.9 | 3.1 | 3.3 |
| 1.8 | 2.0 | 2.1 | 2.5 | 2.7 | 2.8 | 3.0 |
| 1.7 | 1.8 | 1.9 | 2.3 | 2.4 | 2.6 | 2.7 |
| 1.5 | 1.7 | 1.8 | 2.1 | 2.2 | 2.4 | 2.5 |
| 1.4 | 1.5 | 1.6 | 1.9 | 2.0 | 2.2 | 2.3 |
| 1.3 | 1.4 | 1.5 | 1.8 | 1.9 | 2.0 | 2.1 |
| 1.2 | 1.3 | 1.4 | 1.7 | 1.8 | 1.9 | 2.0 |
| 1.1 | 1.2 | 1.3 | 1.5 | 1.6 | 1.7 | 1.9 |
| 1.1 | 1.1 | 1.2 | 1.4 | 1.5 | 1.6 | 1.7 |

For spacings above the dotted lines the safe loads for bending are greater than safe loads for web crippling, as explained on pages 66 to 68 inclusive.

For spacings below the heavy lines the deflections will be greater than the wable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as ows :

$$\text{uired spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 9 Inch No. B 29. | | | | 10 Inch No. B 33. | | | |
| | 21 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 40 lbs. |
| 8 | 25.2 | 27.2 | 30.2 | 33.1 | ... | ... | ... | ... |
| 9 | 19.9 | 21.5 | 23.8 | 26.2 | ... | ... | ... | ... |
| 10 | 16.1 | 17.4 | 19.3 | 21.2 | 20.8 | 22.9 | 25.0 | 27.1 |
| 11 | 13.3 | 14.4 | 16.0 | 17.5 | 17.2 | 18.9 | 20.7 | 22.4 |
| 12 | 11.2 | 12.1 | 13.4 | 14.7 | 14.5 | 15.9 | 17.4 | 18.8 |
| 13 | 9.5 | 10.3 | 11.4 | 12.5 | 12.3 | 13.6 | 14.8 | 16.0 |
| 14 | 8.2 | 8.9 | 9.9 | 10.8 | 10.6 | 11.7 | 12.8 | 13.8 |
| 15 | 7.2 | 7.7 | 8.6 | 9.4 | 9.3 | 10.2 | 11.1 | 12.0 |
| 16 | 6.3 | 6.8 | 7.5 | 8.3 | 8.1 | 8.9 | 9.8 | 10.6 |
| 17 | 5.6 | 6.0 | 6.7 | 7.3 | 7.2 | 7.9 | 8.6 | 9.4 |
| 18 | 5.0 | 5.4 | 6.0 | 6.5 | 6.4 | 7.1 | 7.7 | 8.4 |
| 19 | 4.5 | 4.8 | 5.4 | 5.9 | 5.8 | 6.3 | 6.9 | 7.5 |
| 20 | 4.0 | 4.4 | 4.8 | 5.3 | 5.2 | 5.7 | 6.2 | 6.8 |
| 21 | 3.6 | 4.0 | 4.4 | 4.8 | 4.7 | 5.2 | 5.7 | 6.1 |
| 22 | 3.3 | 3.6 | 4.0 | 4.4 | 4.3 | 4.7 | 5.2 | 5.6 |
| 23 | 3.0 | 3.3 | 3.7 | 4.0 | 3.9 | 4.3 | 4.7 | 5.1 |
| 24 | 2.8 | 3.0 | 3.4 | 3.7 | 3.6 | 4.0 | 4.3 | 4.7 |
| 25 | 2.6 | 2.8 | 3.1 | 3.4 | 3.3 | 3.7 | 4.0 | 4.3 |
| 26 | 2.4 | 2.6 | 2.9 | 3.1 | 3.1 | 3.4 | 3.7 | 4.0 |
| 27 | 2.2 | 2.4 | 2.7 | 2.9 | 2.9 | 3.1 | 3.4 | 3.7 |
| 28 | 2.1 | 2.2 | 2.5 | 2.7 | 2.7 | 2.9 | 3.2 | 3.5 |
| 29 | 1.9 | 2.1 | 2.3 | 2.5 | 2.5 | 2.7 | 3.0 | 3.2 |
| 30 | 1.8 | 1.9 | 2.1 | 2.4 | 2.3 | 2.5 | 2.8 | 3.0 |
| 31 | 1.7 | 1.8 | 2.0 | 2.2 | 2.2 | 2.4 | 2.6 | 2.8 |
| 32 | ... | ... | ... | ... | 2.0 | 2.2 | 2.4 | 2.6 |
| 33 | ... | ... | ... | ... | 1.9 | 2.1 | 2.3 | 2.5 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16000 pounds per square inch.

| STANDARD I-BEAM. | | SPECIAL I-BEAM. | | | |
|---|---|---|---|---|---|
| Inch No. B 41. | | 12 Inch No. B 105. | | | |
| 35 lbs. | 40 lbs. | 40 lbs. | 45 lbs. | 50 lbs. | 55 lbs. |
| 32.5 | 35.0 | 38.3 | 40.6 | 43.1 | 45.7 |
| 26.8 | 28.9 | 31.6 | 33.6 | 35.7 | 37.7 |
| 22.5 | 24.3 | 26.6 | 28.2 | 30.0 | 31.7 |
| 19.2 | 20.7 | 22.6 | 24.0 | 25.5 | 27.0 |
| 16.6 | 17.8 | 19.5 | 20.7 | 22.0 | 23.3 |
| 14.4 | 15.5 | 17.0 | 18.1 | 19.2 | 20.3 |
| 12.7 | 13.7 | 14.9 | 15.9 | 16.9 | 17.8 |
| 11.2 | 12.1 | 13.2 | 14.1 | 14.9 | 15.8 |
| 10.0 | 10.8 | 11.8 | 12.5 | 13.3 | 14.1 |
| 9.0 | 9.7 | 10.6 | 11.3 | 12.0 | 12.6 |
| 8.1 | 8.7 | 9.6 | 10.1 | 10.8 | 11.4 |
| 7.4 | 7.9 | 8.7 | 9.2 | 9.8 | 10.4 |
| 6.7 | 7.2 | 7.9 | 8.4 | 8.9 | 9.4 |
| 6.1 | 6.6 | 7.2 | 7.7 | 8.2 | 8.6 |
| 5.6 | 6.1 | 6.6 | 7.1 | 7.5 | 7.9 |
| 5.2 | 5.6 | 6.1 | 6.5 | 6.9 | 7.3 |
| 4.8 | 5.2 | 5.7 | 6.0 | 6.4 | 6.8 |
| 4.5 | 4.8 | 5.2 | 5.6 | 5.9 | 6.3 |
| 4.1 | 4.5 | 4.9 | 5.2 | 5.5 | 5.8 |
| 3.9 | 4.2 | 4.5 | 4.8 | 5.1 | 5.4 |
| 3.6 | 3.9 | 4.3 | 4.5 | 4.8 | 5.1 |
| 3.4 | 3.6 | 4.0 | 4.2 | 4.5 | 4.8 |
| 3.2 | 3.4 | 3.7 | 4.0 | 4.2 | 4.5 |
| 3.0 | 3.2 | 3.5 | 3.7 | 4.0 | 4.2 |
| 2.8 | 3.0 | 3.3 | 3.5 | 3.7 | 3.9 |
| 2.7 | 2.9 | 3.1 | 3.3 | 3.5 | 3.7 |
| 2.5 | 2.7 | 3.0 | 3.1 | 3.3 | 3.5 |
| 2.4 | 2.5 | 2.7 | 2.9 | 3.1 | 3.3 |

spacings below the heavy lines the deflections will be greater than the
le limit for plastered ceilings = $\frac{1}{360}$ span.
acings for other intensities of loading may be obtained from those in tables as

$$\text{d spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 15 Inch No. B 53. | | | | |
|---|---|---|---|---|---|
| | 42 lbs. | 45 lbs. | 50 lbs. | 55 lbs. | 60 lbs. |
| 10 | 50.3 | 51.9 | 55.0 | 58.1 | 61.3 |
| 11 | 41.5 | 42.9 | 45.5 | 48.0 | 50.6 |
| 12 | 34.9 | 36.0 | 38.2 | 40.4 | 42.6 |
| 13 | 29.7 | 30.7 | 32.5 | 34.4 | 36.3 |
| 14 | 25.6 | 26.5 | 28.1 | 29.7 | 31.3 |
| 15 | 22.3 | 23.1 | 24.4 | 25.8 | 27.2 |
| 16 | 19.6 | 20.3 | 21.5 | 22.7 | 23.9 |
| 17 | 17.4 | 17.9 | 19.0 | 20.1 | 21.2 |
| 18 | 15.5 | 16.0 | 17.0 | 17.9 | 18.9 |
| 19 | 13.9 | 14.4 | 15.2 | 16.1 | 17.0 |
| 20 | 12.6 | 13.0 | 13.8 | 14.5 | 15.3 |
| 21 | 11.4 | 11.8 | 12.5 | 13.2 | 13.9 |
| 22 | 10.4 | 10.7 | 11.4 | 12.0 | 12.7 |
| 23 | 9.5 | 9.8 | 10.4 | 11.0 | 11.6 |
| 24 | 8.7 | 9.0 | 9.5 | 10.1 | 10.6 |
| 25 | 8.0 | 8.3 | 8.8 | 9.3 | 9.8 |
| 26 | 7.4 | 7.7 | 8.1 | 8.6 | 9.1 |
| 27 | 6.9 | 7.1 | 7.5 | 8.0 | 8.4 |
| 28 | 6.4 | 6.6 | 7.0 | 7.4 | 7.8 |
| 29 | 6.0 | 6.2 | 6.5 | 6.9 | 7.3 |
| 30 | 5.6 | 5.8 | 6.1 | 6.5 | 6.8 |
| 31 | 5.2 | 5.4 | 5.7 | 6.1 | 6.4 |
| 32 | 4.9 | 5.1 | 5.4 | 5.7 | 6.0 |
| 33 | 4.6 | 4.8 | 5.1 | 5.3 | 5.6 |
| 34 | 4.3 | 4.5 | 4.8 | 5.0 | 5.3 |
| 35 | 4.1 | 4.2 | 4.5 | 4.7 | 5.0 |
| 36 | 3.9 | 4.0 | 4.2 | 4.5 | 4.7 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 15 Inch No. B 109. | | | | |
|---|---|---|---|---|---|
| | 60 lbs. | 65 lbs. | 70 lbs. | 75 lbs. | 80 lbs. |
| 10 | 69.3 | 72.4 | 75.5 | 78.6 | 81.8 |
| 11 | 57.3 | 59.8 | 62.4 | 65.0 | 67.6 |
| 12 | 48.1 | 50.3 | 52.4 | 54.6 | 56.8 |
| 13 | 41.0 | 42.8 | 44.7 | 46.5 | 48.4 |
| 14 | 35.4 | 36.9 | 38.5 | 40.1 | 41.7 |
| 15 | 30.8 | 32.2 | 33.6 | 35.0 | 36.3 |
| 16 | 27.1 | 28.3 | 29.5 | 30.7 | 31.9 |
| 17 | 24.0 | 25.0 | 26.1 | 27.2 | 28.3 |
| 18 | 21.4 | 22.3 | 23.3 | 24.3 | 25.2 |
| 19 | 19.2 | 20.0 | 20.9 | 21.8 | 22.7 |
| 20 | 17.3 | 18.1 | 18.9 | 19.7 | 20.4 |
| 21 | 15.7 | 16.4 | 17.1 | 17.8 | 18.5 |
| 22 | 14.3 | 15.0 | 15.6 | 16.2 | 16.9 |
| 23 | 13.1 | 13.7 | 14.3 | 14.9 | 15.5 |
| 24 | 12.0 | 12.6 | 13.1 | 13.7 | 14.2 |
| 25 | 11.1 | 11.6 | 12.1 | 12.6 | 13.1 |
| 26 | 10.3 | 10.7 | 11.2 | 11.6 | 12.1 |
| 27 | 9.5 | 9.9 | 10.4 | 10.8 | 11.2 |
| 28 | 8.8 | 9.2 | 9.6 | 10.0 | 10.4 |
| 29 | 8.2 | 8.6 | 9.0 | 9.4 | 9.7 |
| 30 | 7.7 | 8.0 | 8.4 | 8.7 | 9.1 |
| 31 | 7.2 | 7.5 | 7.9 | 8.2 | 8.5 |
| 32 | 6.8 | 7.1 | 7.4 | 7.7 | 8.0 |
| 33 | 6.4 | 6.7 | 6.9 | 7.2 | 7.5 |
| 34 | 6.0 | 6.3 | 6.5 | 6.8 | 7.1 |
| 35 | 5.7 | 5.9 | 6.1 | 6.4 | 6.8 |
| 36 | 5.3 | 5.6 | 5.8 | 6.1 | 6.3 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required } \textit{spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 15 Inch No. B 113. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 89.8 | 92.8 | 96.0 | 99.1 | 102.2 |
| 11 | 74.2 | 76.7 | 79.3 | 81.9 | 84.5 |
| 12 | 62.3 | 64.5 | 66.6 | 68.8 | 71.0 |
| 13 | 53.1 | 54.9 | 56.8 | 58.6 | 60.5 |
| 14 | 45.8 | 47.4 | 49.0 | 50.6 | 52.2 |
| 15 | 39.9 | 41.3 | 42.7 | 44.0 | 45.4 |
| 16 | 35.1 | 36.3 | 37.5 | 38.7 | 39.9 |
| 17 | 31.1 | 32.1 | 33.2 | 34.3 | 35.4 |
| 18 | 27.7 | 28.7 | 29.6 | 30.6 | 31.6 |
| 19 | 24.9 | 25.7 | 26.6 | 27.5 | 28.3 |
| 20 | 22.4 | 23.2 | 24.0 | 24.8 | 25.6 |
| 21 | 20.4 | 21.0 | 21.8 | 22.5 | 23.2 |
| 22 | 18.6 | 19.2 | 19.8 | 20.5 | 21.1 |
| 23 | 17.0 | 17.5 | 18.1 | 18.7 | 19.3 |
| 24 | 15.6 | 16.1 | 16.7 | 17.2 | 17.7 |
| 25 | 14.4 | 14.9 | 15.4 | 15.9 | 16.4 |
| 26 | 13.3 | 13.7 | 14.2 | 14.7 | 15.1 |
| 27 | 12.3 | 12.7 | 13.2 | 13.6 | 14.0 |
| 28 | 11.5 | 11.8 | 12.2 | 12.6 | 13.0 |
| 29 | 10.7 | 11.0 | 11.4 | 11.8 | 12.2 |
| 30 | 10.0 | 10.3 | 10.7 | 11.0 | 11.4 |
| 31 | 9.3 | 9.7 | 10.0 | 10.3 | 10.6 |
| 32 | 8.8 | 9.1 | 9.4 | 9.7 | 10.0 |
| 33 | 8.2 | 8.5 | 8.8 | 9.1 | 9.4 |
| 34 | 7.8 | 8.0 | 8.3 | 8.6 | 8.8 |
| 35 | 7.3 | 7.6 | 7.8 | 8.1 | 8.3 |
| 36 | 6.9 | 7.2 | 7.4 | 7.6 | 7.9 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

*Spacings for other intensities of loading may be obtained from those in tables as follows:*

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 18 Inch No. B 65. | | | | 20 Inch No. B 73. | | |
| | 55 lbs. | 60 lbs. | 65 lbs. | 70 lbs. | 65 lbs. | 70 lbs. | 75 lbs. |
| 10 | 75.4 | 79.8 | 83.6 | 87.3 | 99.8 | 104.1 | 108.3 |
| 11 | 62.3 | 66.0 | 69.1 | 72.2 | 82.5 | 86.0 | 89.5 |
| 12 | 52.4 | 55.4 | 58.0 | 60.7 | 69.3 | 72.3 | 75.2 |
| 13 | 44.6 | 47.2 | 49.5 | 51.7 | 59.1 | 61.6 | 64.1 |
| 14 | 38.5 | 40.7 | 42.6 | 44.6 | 50.9 | 53.1 | 55.2 |
| 15 | 33.5 | 35.5 | 37.1 | 38.8 | 44.4 | 46.3 | 48.1 |
| 16 | 29.5 | 31.2 | 32.6 | 34.1 | 39.0 | 40.7 | 42.3 |
| 17 | 26.1 | 27.6 | 28.9 | 30.2 | 34.5 | 36.0 | 37.5 |
| 18 | 23.3 | 24.6 | 25.8 | 27.0 | 30.8 | 32.1 | 33.4 |
| 19 | 20.9 | 22.1 | 23.2 | 24.2 | 27.6 | 28.8 | 30.0 |
| 20 | 18.9 | 20.0 | 20.9 | 21.8 | 24.9 | 26.0 | 27.1 |
| 21 | 17.1 | 18.1 | 19.0 | 19.8 | 22.6 | 23.6 | 24.6 |
| 22 | 15.6 | 16.5 | 17.3 | 18.0 | 20.6 | 21.5 | 22.4 |
| 23 | 14.3 | 15.1 | 15.8 | 16.5 | 18.9 | 19.7 | 20.5 |
| 24 | 13.1 | 13.9 | 14.5 | 15.2 | 17.3 | 18.1 | 18.8 |
| 25 | 12.1 | 12.8 | 13.4 | 14.0 | 16.0 | 16.7 | 17.3 |
| 26 | 11.2 | 11.8 | 12.4 | 12.9 | 14.8 | 15.4 | 16.0 |
| 27 | 10.3 | 10.9 | 11.5 | 12.0 | 13.7 | 14.3 | 14.9 |
| 28 | 9.6 | 10.2 | 10.7 | 11.1 | 12.7 | 13.3 | 13.8 |
| 29 | 9.0 | 9.5 | 9.9 | 10.4 | 11.9 | 12.4 | 12.9 |
| 30 | 8.4 | 8.9 | 9.3 | 9.7 | 11.1 | 11.6 | 12.0 |
| 31 | 7.8 | 8.3 | 8.7 | 9.1 | 10.4 | 10.8 | 11.3 |
| 32 | 7.4 | 7.8 | 8.2 | 8.5 | 9.7 | 10.2 | 10.6 |
| 33 | 6.9 | 7.3 | 7.7 | 8.0 | 9.2 | 9.6 | 9.9 |
| 34 | 6.5 | 6.9 | 7.2 | 7.6 | 8.6 | 9.0 | 9.4 |
| 35 | 6.2 | 6.5 | 6.8 | 7.1 | 8.1 | 8.5 | 8.8 |
| 36 | 5.8 | 6.2 | 6.4 | 6.7 | 7.7 | 8.0 | 8.4 |

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 20 Inch No. B 121. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 125.1 | 128.7 | 132.9 | 137.1 | 141.3 |
| 11 | 103.4 | 106.4 | 109.8 | 113.3 | 116.8 |
| 12 | 86.9 | 89.4 | 92.3 | 95.2 | 98.1 |
| 13 | 74.0 | 76.2 | 78.6 | 81.1 | 83.6 |
| 14 | 63.8 | 65.7 | 67.8 | 69.9 | 72.1 |
| 15 | 55.6 | 57.2 | 59.1 | 60.9 | 62.8 |
| 16 | 48.9 | 50.3 | 51.9 | 53.6 | 55.2 |
| 17 | 43.3 | 44.5 | 46.0 | 47.4 | 48.9 |
| 18 | 38.6 | 39.7 | 41.0 | 42.3 | 43.6 |
| 19 | 34.7 | 35.7 | 36.8 | 38.0 | 39.1 |
| 20 | 31.3 | 32.2 | 33.2 | 34.3 | 35.3 |
| 21 | 28.4 | 29.2 | 30.1 | 31.1 | 32.0 |
| 22 | 25.9 | 26.6 | 27.5 | 28.3 | 29.2 |
| 23 | 23.7 | 24.3 | 25.1 | 25.9 | 26.7 |
| 24 | 21.7 | 22.3 | 23.1 | 23.8 | 24.5 |
| 25 | 20.0 | 20.6 | 21.3 | 21.9 | 22.6 |
| 26 | 18.5 | 19.0 | 19.7 | 20.3 | 20.9 |
| 27 | 17.2 | 17.7 | 18.2 | 18.8 | 19.4 |
| 28 | 16.0 | 16.4 | 17.0 | 17.5 | 18.0 |
| 29 | 14.9 | 15.3 | 15.8 | 16.3 | 16.8 |
| 30 | 13.9 | 14.3 | 14.8 | 15.2 | 15.7 |
| 31 | 13.0 | 13.4 | 13.8 | 14.3 | 14.7 |
| 32 | 12.2 | 12.6 | 13.0 | 13.4 | 13.8 |
| 33 | 11.5 | 11.8 | 12.2 | 12.6 | 13.0 |
| 34 | 10.8 | 11.1 | 11.5 | 11.9 | 12.2 |
| 35 | 10.2 | 10.5 | 10.8 | 11.2 | 11.5 |
| 36 | 9.7 | 9.9 | 10.3 | 10.6 | 10.9 |

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 125 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 24 Inch No. B 89. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 148.4 | 154.2 | 159.2 | 164.2 | 169.2 |
| 11 | 122.7 | 127.4 | 131.6 | 135.7 | 139.8 |
| 12 | 103.1 | 107.1 | 110.5 | 114.0 | 117.5 |
| 13 | 87.8 | 91.2 | 94.2 | 97.2 | 100.1 |
| 14 | 75.7 | 78.7 | 81.2 | 83.8 | 86.3 |
| 15 | 66.0 | 68.5 | 70.7 | 73.0 | 75.2 |
| 16 | 58.0 | 60.2 | 62.2 | 64.1 | 66.1 |
| 17 | 51.4 | 53.3 | 55.1 | 56.8 | 58.6 |
| 18 | 45.8 | 47.6 | 49.1 | 50.7 | 52.2 |
| 19 | 41.1 | 42.7 | 44.1 | 45.5 | 46.9 |
| 20 | 37.1 | 38.5 | 39.8 | 41.0 | 42.3 |
| 21 | 33.7 | 35.0 | 36.1 | 37.2 | 38.4 |
| 22 | 30.7 | 31.9 | 32.9 | 33.9 | 35.0 |
| 23 | 28.1 | 29.1 | 30.1 | 31.0 | 32.0 |
| 24 | 25.8 | 26.8 | 27.6 | 28.5 | 29.4 |
| 25 | 23.7 | 24.7 | 25.5 | 26.3 | 27.1 |
| 26 | 22.0 | 22.8 | 23.5 | 24.3 | 25.0 |
| 27 | 20.4 | 21.1 | 21.8 | 22.5 | 23.2 |
| 28 | 18.9 | 19.7 | 20.3 | 20.9 | 21.6 |
| 29 | 17.6 | 18.3 | 18.9 | 19.5 | 20.1 |
| 30 | 16.5 | 17.1 | 17.7 | 18.2 | 18.8 |
| 31 | 15.4 | 16.0 | 16.6 | 17.1 | 17.6 |
| 32 | 14.5 | 15.1 | 15.5 | 16.0 | 16.5 |
| 33 | 13.6 | 14.2 | 14.6 | 15.1 | 15.5 |
| 34 | 12.8 | 13.3 | 13.8 | 14.2 | 14.6 |
| 35 | 12.1 | 12.6 | 13.0 | 13.4 | 13.8 |
| 36 | 11.5 | 11.9 | 12.3 | 12.7 | 13.1 |

For spacings above the dotted lines the safe loads for bending are greater than the safe loads for web crippling, as explained on pages 66 to 68 inclusive.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3 Inch No. B 5. | | | 4 Inch No. B 9. | | | |
| | 5.5 lbs. | 6.5 lbs. | 7.5 lbs. | 7.5 lbs. | 8.5 lbs. | 9.5 lbs. | 10.5 lbs. |
| 4 | 7.4 | 8.0 | 8.6 | 13.3 | 14.1 | 15.0 | 15.9 |
| 5 | 4.7 | 5.1 | 5.5 | 8.5 | 9.0 | 9.6 | 10.2 |
| 6 | 3.3 | 3.5 | 3.8 | 5.9 | 6.3 | 6.7 | 7.1 |
| 7 | 2.4 | 2.6 | 2.8 | 4.3 | 4.6 | 4.9 | 5.2 |
| 8 | 1.8 | 2.0 | 2.2 | 3.3 | 3.5 | 3.7 | 4.0 |
| 9 | 1.5 | 1.6 | 1.7 | 2.6 | 2.8 | 3.0 | 3.1 |
| 10 | 1.2 | 1.3 | 1.4 | 2.1 | 2.3 | 2.4 | 2.5 |
| 11 | 1.0 | 1.1 | 1.1 | 1.8 | 1.9 | 2.0 | 2.1 |
| 12 | ... | ... | 1.0 | 1.5 | 1.6 | 1.7 | 1.8 |
| 13 | ... | ... | ... | 1.3 | 1.3 | 1.4 | 1.5 |
| 14 | ... | ... | ... | 1.1 | 1.2 | 1.2 | 1.3 |
| 15 | ... | ... | ... | ... | 1.0 | 1.1 | 1.1 |
| 16 | ... | ... | ... | ... | ... | ... | 1.0 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | |
|---|---|---|---|---|---|---|
| | 5 Inch No. B 13. | | | 6 Inch No. B 17. | | |
| | 9.75 lbs. | 12.25 lbs. | 14.75 lbs. | 12.25 lbs. | 14.75 lbs. | 17.25 lbs. |
| 4 | 21.5 | 24.2 | 26.9 | 32.3 | 35.5 | 38.8 |
| 5 | 13.8 | 15.5 | 17.2 | 20.7 | 22.7 | 24.8 |
| 6 | 9.6 | 10.8 | 12.0 | 14.3 | 15.8 | 17.2 |
| 7 | 7.0 | 7.9 | 8.8 | 10.5 | 11.6 | 12.7 |
| 8 | 5.4 | 6.1 | 6.7 | 8.1 | 8.9 | 9.7 |
| 9 | 4.2 | 4.8 | 5.3 | 6.4 | 7.0 | 7.7 |
| 10 | 3.4 | 3.9 | 4.3 | 5.2 | 5.7 | 6.2 |
| 11 | 2.8 | 3.2 | 3.6 | 4.3 | 4.7 | 5.1 |
| 12 | 2.4 | 2.7 | 3.0 | 3.6 | 3.9 | 4.3 |
| 13 | 2.0 | 2.3 | 2.5 | 3.1 | 3.4 | 3.7 |
| 14 | 1.8 | 2.0 | 2.2 | 2.6 | 2.9 | 3.2 |
| 15 | 1.5 | 1.7 | 1.9 | 2.3 | 2.5 | 2.8 |
| 16 | 1.3 | 1.5 | 1.7 | 2.0 | 2.2 | 2.4 |
| 17 | 1.2 | 1.3 | 1.5 | 1.8 | 2.0 | 2.1 |
| 18 | 1.1 | 1.2 | 1.3 | 1.6 | 1.8 | 1.9 |
| 19 | 1.0 | 1.1 | 1.2 | 1.4 | 1.6 | 1.7 |
| 20 | .... | 1.0 | 1.1 | 1.3 | 1.4 | 1.6 |
| 21 | .... | .... | 1.0 | 1.2 | 1.3 | 1.4 |
| 22 | .... | .... | .... | 1.1 | 1.2 | 1.3 |
| 23 | .... | .... | .... | 1.0 | 1.1 | 1.2 |
| 24 | .... | .... | .... | .... | 1.0 | 1.1 |
| 25 | .... | .... | .... | .... | .... | 1.0 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{350}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required } \textit{spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 7 Inch No. B 21. | | | 8 Inch No. B 25. | | | |
| | 15 lbs. | 17.5 lbs. | 20 lbs. | 18.00 lbs. | 20.25 lbs. | 22.75 lbs. | 25.25 lbs. |
| 4 | 46.0 | 49.8 | 53.6 | 63.2 | 66.9 | 71.2 | 75.6 |
| 5 | 29.4 | 31.8 | 34.3 | 40.4 | 42.8 | 45.6 | 48.4 |
| 6 | 20.4 | 22.1 | 23.8 | 28.1 | 29.7 | 31.7 | 33.6 |
| 7 | 15.0 | 16.2 | 17.5 | 20.6 | 21.8 | 23.3 | 24.7 |
| 8 | 11.5 | 12.4 | 13.4 | 15.8 | 16.7 | 17.8 | 18.9 |
| 9 | 9.1 | 9.8 | 10.6 | 12.5 | 13.2 | 14.1 | 14.9 |
| 10 | 7.4 | 8.0 | 8.6 | 10.1 | 10.7 | 11.4 | 12.1 |
| 11 | 6.1 | 6.6 | 7.1 | 8.4 | 8.8 | 9.4 | 10.0 |
| 12 | 5.1 | 5.5 | 6.0 | 7.0 | 7.4 | 7.9 | 8.4 |
| 13 | 4.4 | 4.7 | 5.1 | 6.0 | 6.3 | 6.7 | 7.2 |
| 14 | 3.8 | 4.1 | 4.4 | 5.2 | 5.5 | 5.8 | 6.2 |
| 15 | 3.3 | 3.5 | 3.8 | 4.5 | 4.8 | 5.1 | 5.4 |
| 16 | 2.9 | 3.1 | 3.3 | 3.9 | 4.2 | 4.5 | 4.7 |
| 17 | 2.5 | 2.8 | 3.0 | 3.5 | 3.7 | 3.9 | 4.2 |
| 18 | 2.3 | 2.5 | 2.6 | 3.1 | 3.3 | 3.5 | 3.7 |
| 19 | 2.0 | 2.2 | 2.4 | 2.8 | 3.0 | 3.2 | 3.4 |
| 20 | 1.8 | 2.0 | 2.1 | 2.5 | 2.7 | 2.8 | 3.0 |
| 21 | 1.7 | 1.8 | 1.9 | 2.3 | 2.4 | 2.6 | 2.7 |
| 22 | 1.5 | 1.6 | 1.8 | 2.1 | 2.2 | 2.4 | 2.5 |
| 23 | 1.4 | 1.5 | 1.6 | 1.9 | 2.0 | 2.2 | 2.3 |
| 24 | 1.3 | 1.4 | 1.5 | 1.8 | 1.9 | 2.0 | 2.1 |
| 25 | 1.2 | 1.3 | 1.4 | 1.6 | 1.7 | 1.8 | 1.9 |
| 26 | 1.1 | 1.2 | 1.3 | 1.5 | 1.6 | 1.7 | 1.8 |
| 27 | 1.0 | 1.1 | 1.2 | 1.4 | 1.5 | 1.6 | 1.7 |
| 28 | .... | 1.0 | 1.1 | 1.3 | 1.4 | 1.5 | 1.5 |
| 29 | .... | .... | 1.0 | 1.2 | 1.3 | 1.4 | 1.4 |

For spacings above the dotted lines the safe loads for bending are greater than the safe loads for web crippling, as explained on pages 66 to 68 inclusive.

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

*Spacings for other* intensities of loading may be obtained from those in tables as *follows:*

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 9 Inch No. B 29. | | | | 10 Inch No. B 33. | | | |
| | 21 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 40 lbs. |
| 8 | 21.0 | 22.7 | 25.2 | 27.6 | .... | .... | .... | .... |
| 9 | 16.6 | 17.9 | 19.9 | 21.8 | .... | .... | .... | .... |
| 10 | 13.4 | 14.5 | 16.1 | 17.7 | 17.4 | 19.1 | 20.8 | 22.6 |
| 11 | 11.1 | 12.0 | 13.3 | 14.6 | 14.4 | 15.8 | 17.2 | 18.7 |
| 12 | 9.3 | 10.1 | 11.2 | 12.3 | 12.1 | 13.3 | 14.5 | 15.7 |
| 13 | 7.9 | 8.6 | 9.5 | 10.5 | 10.3 | 11.3 | 12.3 | 13.3 |
| 14 | 6.8 | 7.4 | 8.2 | 9.0 | 8.9 | 9.7 | 10.6 | 11.5 |
| 15 | 6.0 | 6.5 | 7.2 | 7.9 | 7.7 | 8.5 | 9.3 | 10.0 |
| 16 | 5.2 | 5.7 | 6.3 | 6.9 | 6.8 | 7.5 | 8.1 | 8.8 |
| 17 | 4.6 | 5.0 | 5.6 | 6.1 | 6.0 | 6.6 | 7.2 | 7.8 |
| 18 | 4.1 | 4.5 | 5.0 | 5.5 | 5.4 | 5.9 | 6.4 | 7.0 |
| 19 | 3.7 | 4.0 | 4.5 | 4.9 | 4.8 | 5.3 | 5.8 | 6.3 |
| 20 | 3.4 | 3.6 | 4.0 | 4.4 | 4.4 | 4.8 | 5.2 | 5.6 |
| 21 | 3.0 | 3.3 | 3.7 | 4.0 | 3.9 | 4.3 | 4.7 | 5.1 |
| 22 | 2.8 | 3.0 | 3.3 | 3.7 | 3.6 | 3.9 | 4.3 | 4.7 |
| 23 | 2.5 | 2.7 | 3.0 | 3.3 | 3.3 | 3.6 | 3.9 | 4.3 |
| 24 | 2.3 | 2.5 | 2.8 | 3.1 | 3.0 | 3.3 | 3.6 | 3.9 |
| 25 | 2.1 | 2.3 | 2.6 | 2.8 | 2.8 | 3.1 | 3.3 | 3.6 |
| 26 | 2.0 | 2.1 | 2.4 | 2.6 | 2.6 | 2.8 | 3.1 | 3.3 |
| 27 | 1.8 | 2.0 | 2.2 | 2.4 | 2.4 | 2.6 | 2.9 | 3.1 |
| 28 | 1.7 | 1.9 | 2.1 | 2.3 | 2.2 | 2.4 | 2.7 | 2.9 |
| 29 | 1.6 | 1.7 | 1.9 | 2.1 | 2.1 | 2.3 | 2.5 | 2.7 |
| 30 | 1.5 | 1.6 | 1.8 | 2.0 | 1.9 | 2.1 | 2.3 | 2.5 |
| 31 | 1.4 | 1.5 | 1.7 | 1.8 | 1.8 | 2.0 | 2.2 | 2.3 |
| 32 | .... | .... | .... | .... | 1.7 | 1.9 | 2.0 | 2.2 |
| 33 | .... | .... | .... | .... | 1.6 | 1.8 | 1.9 | 2.1 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required } \textit{spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 12 Inch No. B 41. | | | SPECIAL I-BEAM. 12 Inch No. B 105. | | | |
|---|---|---|---|---|---|---|---|
| | 31.5 lbs. | 35 lbs. | 40 lbs. | 40 lbs. | 45 lbs. | 50 lbs. | 55 lbs. |
| 10 | 25.6 | 27.1 | 29.1 | 31.9 | 33.9 | 36.9 | 38.0 |
| 11 | 21.1 | 22.4 | 24.1 | 26.3 | 28.0 | 29.7 | 31.4 |
| 12 | 17.8 | 18.8 | 20.2 | 22.1 | 23.5 | 25.0 | 26.4 |
| 13 | 15.1 | 16.0 | 17.2 | 18.9 | 20.0 | 21.3 | 22.5 |
| 14 | 13.1 | 13.8 | 14.9 | 16.3 | 17.3 | 18.3 | 19.4 |
| 15 | 11.4 | 12.0 | 13.0 | 14.2 | 15.1 | 16.0 | 16.9 |
| 16 | 10.0 | 10.6 | 11.4 | 12.5 | 13.2 | 14.0 | 14.9 |
| 17 | 8.9 | 9.4 | 10.1 | 11.0 | 11.7 | 12.4 | 13.2 |
| 18 | 7.9 | 8.3 | 9.0 | 9.8 | 10.5 | 11.1 | 11.7 |
| 19 | 7.1 | 7.5 | 8.1 | 8.8 | 9.4 | 10.0 | 10.5 |
| 20 | 6.4 | 6.8 | 7.3 | 8.0 | 8.5 | 9.0 | 9.5 |
| 21 | 5.8 | 6.1 | 6.6 | 7.2 | 7.7 | 8.2 | 8.6 |
| 22 | 5.3 | 5.6 | 6.0 | 6.6 | 7.0 | 7.4 | 7.9 |
| 23 | 4.8 | 5.1 | 5.5 | 6.0 | 6.4 | 6.8 | 7.2 |
| 24 | 4.4 | 4.7 | 5.1 | 5.5 | 5.9 | 6.2 | 6.6 |
| 25 | 4.1 | 4.3 | 4.7 | 5.1 | 5.4 | 5.8 | 6.1 |
| 26 | 3.8 | 4.0 | 4.3 | 4.7 | 5.0 | 5.3 | 5.6 |
| 27 | 3.5 | 3.7 | 4.0 | 4.4 | 4.6 | 4.9 | 5.2 |
| 28 | 3.3 | 3.5 | 3.7 | 4.1 | 4.3 | 4.6 | 4.9 |
| 29 | 3.0 | 3.2 | 3.5 | 3.8 | 4.0 | 4.3 | 4.5 |
| 30 | 2.8 | 3.0 | 3.2 | 3.5 | 3.8 | 4.0 | 4.2 |
| 31 | 2.7 | 2.8 | 3.0 | 3.3 | 3.5 | 3.7 | 4.0 |
| 32 | 2.5 | 2.6 | 2.8 | 3.1 | 3.3 | 3.5 | 3.7 |
| 33 | 2.3 | 2.5 | 2.7 | 2.9 | 3.1 | 3.3 | 3.5 |
| 34 | 2.2 | 2.3 | 2.5 | 2.8 | 2.9 | 3.1 | 3.3 |
| 35 | 2.1 | 2.2 | 2.4 | 2.6 | 2.8 | 2.9 | 3.1 |
| 36 | 2.0 | 2.1 | 2.2 | 2.5 | 2.6 | 2.8 | 2.9 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

*Spacings for* other intensities of loading may be obtained from those in tables as *follows:*

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## ACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| STANDARD I-BEAM. | | | | |
|---|---|---|---|---|
| 15 Inch No. B 53. | | | | |
| 42 lbs. | 45 lbs. | 50 lbs. | 55 lbs. | 60 lbs. |
| 41.9 | 43.2 | 45.8 | 48.4 | 51.1 |
| 34.6 | 35.7 | 37.9 | 40.0 | 42.1 |
| 29.1 | 30.0 | 31.8 | 33.6 | 35.5 |
| 24.8 | 25.6 | 27.1 | 28.7 | 30.2 |
| 21.4 | 22.1 | 23.4 | 24.7 | 26.1 |
| 18.6 | 19.2 | 20.4 | 21.5 | 22.7 |
| 16.4 | 16.9 | 17.9 | 18.9 | 19.9 |
| 14.5 | 15.0 | 15.9 | 16.8 | 17.7 |
| 12.9 | 13.3 | 14.1 | 15.0 | 15.8 |
| 11.6 | 12.0 | 12.7 | 13.4 | 14.1 |
| 10.5 | 10.8 | 11.5 | 12.1 | 12.8 |
| 9.5 | 9.8 | 10.4 | 11.0 | 11.6 |
| 8.7 | 8.9 | 9.5 | 10.0 | 10.6 |
| 7.9 | 8.2 | 8.7 | 9.2 | 9.7 |
| 7.3 | 7.5 | 8.0 | 8.4 | 8.9 |
| 6.7 | 6.9 | 7.3 | 7.8 | 8.2 |
| 6.2 | 6.4 | 6.8 | 7.2 | 7.6 |
| 5.7 | 5.9 | 6.3 | 6.6 | 7.0 |
| 5.3 | 5.5 | 5.8 | 6.2 | 6.5 |
| 5.0 | 5.1 | 5.5 | 5.8 | 6.1 |
| 4.7 | 4.8 | 5.1 | 5.4 | 5.7 |
| 4.4 | 4.5 | 4.8 | 5.0 | 5.3 |
| 4.1 | 4.2 | 4.5 | 4.7 | 5.0 |
| 3.8 | 4.0 | 4.2 | 4.4 | 4.7 |
| 3.6 | 3.7 | 4.0 | 4.2 | 4.4 |
| 3.4 | 3.5 | 3.7 | 4.0 | 4.2 |
| 3.2 | 3.3 | 3.5 | 3.8 | 3.9 |

r spacings below the heavy lines the deflections will be greater than the ble limit for plastered ceilings = $\frac{1}{360}$ span.
acings for other intenskies of loading may be obtained from those in tables as :

$$\text{d spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 15 Inch No. B 109. | | | | |
|---|---|---|---|---|---|
| | 60 lbs. | 65 lbs. | 70 lbs. | 75 lbs. | 80 lbs. |
| 10 | 57.7 | 60.3 | 62.9 | 65.5 | 68.2 |
| 11 | 47.7 | 49.8 | 52.0 | 54.2 | 56.3 |
| 12 | 40.1 | 41.9 | 43.7 | 45.5 | 47.3 |
| 13 | 34.2 | 35.7 | 37.2 | 38.8 | 40.3 |
| 14 | 29.5 | 30.8 | 32.1 | 33.4 | 34.8 |
| 15 | 25.7 | 26.8 | 28.0 | 29.1 | 30.3 |
| 16 | 22.6 | 23.6 | 24.6 | 25.6 | 26.6 |
| 17 | 20.0 | 20.9 | 21.8 | 22.7 | 23.6 |
| 18 | 17.8 | 18.6 | 19.4 | 20.2 | 21.0 |
| 19 | 16.0 | 16.7 | 17.4 | 18.2 | 18.9 |
| 20 | 14.4 | 15.1 | 15.7 | 16.4 | 17.0 |
| 21 | 13.1 | 13.7 | 14.3 | 14.9 | 15.5 |
| 22 | 11.9 | 12.5 | 13.0 | 13.5 | 14.1 |
| 23 | 10.9 | 11.4 | 11.9 | 12.4 | 12.9 |
| 24 | 10.0 | 10.5 | 10.9 | 11.4 | 11.8 |
| 25 | 9.2 | 9.6 | 10.1 | 10.5 | 10.9 |
| 26 | 8.5 | 8.9 | 9.3 | 9.7 | 10.1 |
| 27 | 7.9 | 8.3 | 8.6 | 9.0 | 9.3 |
| 28 | 7.4 | 7.7 | 8.0 | 8.4 | 8.7 |
| 29 | 6.9 | 7.2 | 7.5 | 7.8 | 8.1 |
| 30 | 6.4 | 6.7 | 7.0 | 7.3 | 7.6 |
| 31 | 6.0 | 6.3 | 6.5 | 6.8 | 7.1 |
| 32 | 5.6 | 5.9 | 6.1 | 6.4 | 6.7 |
| 33 | 5.3 | 5.5 | 5.8 | 6.0 | 6.3 |
| 34 | 5.0 | 5.2 | 5.4 | 5.7 | 5.9 |
| 35 | 4.7 | 4.9 | 5.1 | 5.4 | 5.6 |
| 36 | 4.5 | 4.7 | 4.9 | 5.1 | 5.3 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 15 Inch No. B 113. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 74.8 | 77.4 | 80.0 | 82.6 | 85.2 |
| 11 | 61.8 | 63.9 | 66.1 | 68.3 | 70.4 |
| 12 | 52.0 | 53.7 | 55.5 | 57.4 | 59.2 |
| 13 | 44.3 | 45.8 | 47.3 | 48.9 | 50.4 |
| 14 | 38.2 | 39.5 | 40.8 | 42.1 | 43.5 |
| 15 | 33.3 | 34.4 | 35.5 | 36.7 | 37.9 |
| 16 | 29.2 | 30.2 | 31.2 | 32.3 | 33.3 |
| 17 | 25.9 | 26.8 | 27.7 | 28.6 | 29.5 |
| 18 | 23.1 | 23.9 | 24.7 | 25.5 | 26.3 |
| 19 | 20.7 | 21.4 | 22.2 | 22.9 | 23.6 |
| 20 | 18.7 | 19.3 | 20.0 | 20.6 | 21.3 |
| 21 | 17.0 | 17.5 | 18.1 | 18.7 | 19.3 |
| 22 | 15.5 | 16.0 | 16.5 | 17.1 | 17.6 |
| 23 | 14.1 | 14.6 | 15.1 | 15.6 | 16.1 |
| 24 | 13.0 | 13.4 | 13.9 | 14.3 | 14.8 |
| 25 | 12.0 | 12.4 | 12.8 | 13.2 | 13.6 |
| 26 | 11.1 | 11.4 | 11.8 | 12.2 | 12.6 |
| 27 | 10.3 | 10.6 | 11.0 | 11.3 | 11.7 |
| 28 | 9.5 | 9.9 | 10.2 | 10.5 | 10.9 |
| 29 | 8.9 | 9.2 | 9.5 | 9.8 | 10.1 |
| 30 | 8.3 | 8.6 | 8.9 | 9.2 | 9.5 |
| 31 | 7.8 | 8.0 | 8.3 | 8.6 | 8.9 |
| 32 | 7.3 | 7.6 | 7.8 | 8.1 | 8.3 |
| 33 | 6.9 | 7.1 | 7.3 | 7.6 | 7.8 |
| 34 | 6.5 | 6.7 | 6.9 | 7.1 | 7.4 |
| 35 | 6.1 | 6.3 | 6.5 | 6.7 | 7.0 |
| 36 | 5.8 | 6.0 | 6.2 | 6.4 | 6.6 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR U FORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | |
|---|---|---|---|---|---|---|
| | 18 Inch No. B 65. | | | | 20 Inch No. B | |
| | 55 lbs. | 60 lbs. | 65 lbs. | 70 lbs. | 65 lbs. | 70 lbs. |
| 10 | 62.9 | 66.5 | 69.6 | 72.8 | 83.2 | 86.7 |
| 11 | 51.9 | 55.0 | 57.6 | 60.2 | 68.7 | 71.7 |
| 12 | 43.7 | 46.2 | 48.4 | 50.5 | 57.8 | 60.2 |
| 13 | 37.2 | 39.4 | 41.2 | 43.1 | 49.2 | 51.3 |
| 14 | 32.1 | 33.9 | 35.5 | 37.1 | 42.4 | 44.3 |
| 15 | 27.9 | 29.6 | 31.0 | 32.3 | 37.0 | 38.5 |
| 16 | 24.6 | 26.0 | 27.2 | 28.4 | 32.5 | 33.9 |
| 17 | 21.8 | 23.0 | 24.1 | 25.2 | 28.8 | 30.0 |
| 18 | 19.4 | 20.5 | 21.5 | 22.5 | 25.7 | 26.8 |
| 19 | 17.4 | 18.4 | 19.3 | 20.2 | 23.0 | 24.0 |
| 20 | 15.7 | 16.6 | 17.4 | 18.2 | 20.8 | 21.7 |
| 21 | 14.3 | 15.1 | 15.8 | 16.5 | 18.9 | 19.7 |
| 22 | 13.0 | 13.7 | 14.4 | 15.0 | 17.2 | 17.9 |
| 23 | 11.9 | 12.6 | 13.2 | 13.8 | 15.7 | 16.4 |
| 24 | 10.9 | 11.5 | 12.1 | 12.6 | 14.4 | 15.1 |
| 25 | 10.1 | 10.6 | 11.1 | 11.6 | 13.3 | 13.9 |
| 26 | 9.3 | 9.8 | 10.3 | 10.8 | 12.3 | 12.8 |
| 27 | 8.6 | 9.1 | 9.6 | 10.0 | 11.4 | 11.9 |
| 28 | 8.0 | 8.5 | 8.9 | 9.3 | 10.6 | 11.1 |
| 29 | 7.5 | 7.9 | 8.3 | 8.7 | 9.9 | 10.3 |
| 30 | 7.0 | 7.4 | 7.7 | 8.1 | 9.2 | 9.6 |
| 31 | 6.5 | 6.9 | 7.2 | 7.6 | 8.7 | 9.0 |
| 32 | 6.1 | 6.5 | 6.8 | 7.1 | 8.1 | 8.5 |
| 33 | 5.8 | 6.1 | 6.4 | 6.7 | 7.6 | 8.0 |
| 34 | 5.4 | 5.8 | 6.0 | 6.3 | 7.2 | 7.5 |
| 35 | 5.1 | 5.4 | 5.7 | 5.9 | 6.8 | 7.1 |
| 36 | 4.9 | 5.1 | 5.4 | 5.6 | 6.4 | 6.7 |

Spacings for other intensities of loading may be obtained from those in t
*follows:*

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing for}$$

## ACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| SPECIAL I-BEAM. 20 Inch No. B 121. | | | | |
|---|---|---|---|---|
| 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 104.3 | 107.3 | 110.8 | 114.2 | 117.7 |
| 86.2 | 88.7 | 91.5 | 94.4 | 97.3 |
| 72.4 | 74.5 | 76.9 | 79.3 | 81.8 |
| 61.7 | 63.5 | 65.5 | 67.6 | 69.7 |
| 53.2 | 54.7 | 56.5 | 58.3 | 60.1 |
| 46.3 | 47.7 | 49.2 | 50.8 | 52.3 |
| 40.7 | 41.9 | 43.3 | 44.6 | 46.0 |
| 36.1 | 37.1 | 38.3 | 39.5 | 40.7 |
| 32.2 | 33.1 | 34.2 | 35.3 | 36.3 |
| 28.9 | 29.7 | 30.7 | 31.6 | 32.6 |
| 26.1 | 26.8 | 27.7 | 28.6 | 29.4 |
| 23.6 | 24.3 | 25.1 | 25.9 | 26.7 |
| 21.5 | 22.2 | 22.9 | 23.6 | 24.3 |
| 19.7 | 20.3 | 20.9 | 21.6 | 22.3 |
| 18.1 | 18.6 | 19.2 | 19.8 | 20.4 |
| 16.7 | 17.2 | 17.7 | 18.3 | 18.8 |
| 15.4 | 15.9 | 16.4 | 16.9 | 17.4 |
| 14.3 | 14.7 | 15.2 | 15.7 | 16.1 |
| 13.3 | 13.7 | 14.1 | 14.6 | 15.0 |
| 12.4 | 12.8 | 13.2 | 13.6 | 14.0 |
| 11.6 | 11.9 | 12.3 | 12.7 | 13.1 |
| 10.9 | 11.2 | 11.5 | 11.9 | 12.3 |
| 10.2 | 10.5 | 10.8 | 11.2 | 11.5 |
| 9.6 | 9.9 | 10.2 | 10.5 | 10.8 |
| 9.0 | 9.3 | 9.6 | 9.9 | 10.2 |
| 8.5 | 8.8 | 9.0 | 9.3 | 9.6 |
| 8.0 | 8.3 | 8.5 | 8.8 | 9.1 |

cings for other intensities of loading may be obtained from those in tables as

$$d \text{ spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR U FORM LOAD OF 150 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 24 Inch No. B 89. | | | |
|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. |
| 10 | 123.7 | 128.5 | 132.6 | 136.8 |
| 11 | 102.2 | 106.2 | 109.6 | 113.1 |
| 12 | 85.9 | 89.2 | 92.1 | 95.0 |
| 13 | 73.2 | 76.0 | 78.5 | 81.0 |
| 14 | 63.1 | 65.5 | 67.7 | 69.8 |
| 15 | 55.0 | 57.1 | 59.0 | 60.8 |
| 16 | 48.3 | 50.2 | 51.8 | 53.4 |
| 17 | 42.8 | 44.5 | 45.9 | 47.3 |
| 18 | 38.2 | 39.6 | 40.9 | 42.2 |
| 19 | 34.3 | 35.6 | 36.7 | 37.9 |
| 20 | 30.9 | 32.1 | 33.2 | 34.2 |
| 21 | 28.0 | 29.1 | 30.1 | 31.0 |
| 22 | 25.6 | 26.5 | 27.4 | 28.3 |
| 23 | 23.4 | 24.3 | 25.1 | 25.9 |
| 24 | 21.5 | 22.3 | 23.0 | 23.8 |
| 25 | 19.8 | 20.6 | 21.2 | 21.9 |
| 26 | 18.3 | 19.0 | 19.6 | 20.2 |
| 27 | 17.0 | 17.6 | 18.2 | 18.8 |
| 28 | 15.8 | 16.4 | 16.9 | 17.5 |
| 29 | 14.7 | 15.3 | 15.8 | 16.3 |
| 30 | 13.7 | 14.3 | 14.7 | 15.2 |
| 31 | 12.9 | 13.4 | 13.8 | 14.2 |
| 32 | 12.1 | 12.5 | 13.0 | 13.4 |
| 33 | 11.4 | 11.8 | 12.2 | 12.6 |
| 34 | 10.7 | 11.1 | 11.5 | 11.8 |
| 35 | 10.1 | 10.5 | 10.8 | 11.2 |
| 36 | 9.5 | 9.9 | 10.2 | 10.6 |

For spacings above the dotted lines the safe loads for bending are gre the safe loads for web crippling, as explained on pages 66 to 68 inclusive.

*Spacings* for other intensities of loading may be obtained from those in *follows:*

$$\textit{Required spacing} = \frac{\textit{Intensity of loading from table}}{\textit{New intensity of loading}} \times \text{Computed spacing}$$

## ACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

### STANDARD I-BEAMS.

| 3 Inch No. B 5. | | | 4 Inch No. B 9. | | | |
|---|---|---|---|---|---|---|
| 5.5 lbs. | 6.5 lbs. | 7.5 lbs. | 7.5 lbs. | 8.5 lbs. | 9.5 lbs. | 10.5 lbs. |
| 6.3 | 6.8 | 7.4 | 11.4 | 12.1 | 12.9 | 13.6 |
| 4.0 | 4.4 | 4.7 | 7.3 | 7.7 | 8.2 | 8.7 |
| 2.8 | 3.0 | 3.3 | 5.0 | 5.4 | 5.7 | 6.0 |
| 2.1 | 2.2 | 2.7 | 3.7 | 4.0 | 4.2 | 4.4 |
| 1.6 | 1.7 | 1.8 | 2.8 | 3.0 | 3.2 | 3.4 |
| 1.2 | 1.4 | 1.5 | 2.2 | 2.4 | 2.5 | 2.7 |
| 1.0 | 1.1 | 1.2 | 1.8 | 1.9 | 2.1 | 2.2 |
| .... | .... | 1.0 | 1.5 | 1.6 | 1.7 | 1.8 |
| .... | .... | .... | 1.3 | 1.3 | 1.4 | 1.5 |
| .... | .... | .... | 1.1 | 1.1 | 1.2 | 1.3 |
| .... | .... | .... | .... | 1.0 | 1.0 | 1.1 |
| .... | .... | .... | .... | .... | .... | 1.0 |

spacings below the heavy lines the deflections will be greater than the
: limit for plastered ceilings = $\frac{1}{360}$ span.
ings for other intensities of loading may be obtained from those in tables as

$$\text{l spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | |
|---|---|---|---|---|---|---|
| | 5 Inch No. B 13. | | | 6 Inch No. B 17. | | |
| | 9.75 lbs. | 12.25 lbs. | 14.75 lbs. | 12.25 lbs. | 14.75 lbs. | 17.25 lbs. |
| 4 | 18.4 | 20.7 | 23.1 | 27.7 | 30.5 | 33.3 |
| 5 | 11.8 | 13.3 | 14.8 | 17.7 | 19.5 | 21.3 |
| 6 | 8.2 | 9.2 | 10.3 | 12.3 | 13.5 | 14.8 |
| 7 | 6.0 | 6.8 | 7.5 | 9.0 | 9.9 | 10.9 |
| 8 | 4.6 | 5.2 | 5.8 | 6.9 | 7.6 | 8.3 |
| 9 | 3.6 | 4.1 | 4.6 | 5.5 | 6.0 | 6.6 |
| 10 | 2.9 | 3.3 | 3.7 | 4.4 | 4.9 | 5.3 |
| 11 | 2.4 | 2.7 | 3.1 | 3.7 | 4.0 | 4.4 |
| 12 | 2.0 | 2.3 | 2.6 | 3.1 | 3.4 | 3.7 |
| 13 | 1.7 | 2.0 | 2.2 | 2.6 | 2.9 | 3.1 |
| 14 | 1.5 | 1.7 | 1.9 | 2.3 | 2.5 | 2.7 |
| 15 | 1.3 | 1.4 | 1.6 | 2.0 | 2.2 | 2.4 |
| 16 | 1.2 | 1.3 | 1.4 | 1.7 | 1.9 | 2.1 |
| 17 | 1.0 | 1.1 | 1.3 | 1.5 | 1.7 | 1.8 |
| 18 | .... | 1.0 | 1.1 | 1.4 | 1.5 | 1.6 |
| 19 | .... | .... | 1.0 | 1.2 | 1.3 | 1.5 |
| 20 | .... | .... | .... | 1.1 | 1.2 | 1.3 |
| 21 | .... | .... | .... | 1.0 | 1.1 | 1.2 |
| 22 | .... | .... | .... | .... | 1.0 | 1.1 |
| 23 | .... | .... | .... | .... | .... | 1.0 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings $= \frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 7 Inch No. B 21. | | | 8 Inch No. B 25. | | | |
| | 15 lbs. | 17.5 lbs. | 20 lbs. | 18.00 lbs. | 20.25 lbs. | 22.75 lbs. | 25.25 lbs. |
| 4 | 39.4 | 42.6 | 45.9 | 54.2 | 57.3 | 61.1 | 64.8 |
| 5 | 25.2 | 27.3 | 29.4 | 34.7 | 36.7 | 39.1 | 41.5 |
| 6 | 17.5 | 19.0 | 20.4 | 24.1 | 25.5 | 27.1 | 28.8 |
| 7 | 12.9 | 13.9 | 15.0 | 17.7 | 18.7 | 19.9 | 21.2 |
| 8 | 9.9 | 10.7 | 11.5 | 13.5 | 14.3 | 15.3 | 16.2 |
| 9 | 7.8 | 8.4 | 9.1 | 10.7 | 11.3 | 12.1 | 12.8 |
| 10 | 6.3 | 6.8 | 7.3 | 8.7 | 9.2 | 9.8 | 10.4 |
| 11 | 5.2 | 5.6 | 6.1 | 7.2 | 7.6 | 8.1 | 8.6 |
| 12 | 4.4 | 4.7 | 5.1 | 6.0 | 6.4 | 6.8 | 7.2 |
| 13 | 3.7 | 4.0 | 4.3 | 5.1 | 5.4 | 5.8 | 6.1 |
| 14 | 3.2 | 3.5 | 3.7 | 4.4 | 4.7 | 5.0 | 5.3 |
| 15 | 2.8 | 3.0 | 3.3 | 3.9 | 4.1 | 4.3 | 4.6 |
| 16 | 2.5 | 2.7 | 2.9 | 3.4 | 3.6 | 3.8 | 4.0 |
| 17 | 2.2 | 2.4 | 2.5 | 3.0 | 3.2 | 3.4 | 3.6 |
| 18 | 1.9 | 2.1 | 2.3 | 2.7 | 2.8 | 3.0 | 3.2 |
| 19 | 1.7 | 1.9 | 2.0 | 2.4 | 2.5 | 2.7 | 2.9 |
| 20 | 1.6 | 1.7 | 1.8 | 2.2 | 2.3 | 2.4 | 2.6 |
| 21 | 1.4 | 1.5 | 1.7 | 2.0 | 2.1 | 2.2 | 2.4 |
| 22 | 1.3 | 1.4 | 1.5 | 1.8 | 1.9 | 2.0 | 2.1 |
| 23 | 1.2 | 1.3 | 1.4 | 1.6 | 1.7 | 1.8 | 2.0 |
| 24 | 1.1 | 1.2 | 1.3 | 1.5 | 1.6 | 1.7 | 1.8 |
| 25 | 1.0 | 1.1 | 1.2 | 1.4 | 1.5 | 1.6 | 1.7 |
| 26 | ... | 1.0 | 1.1 | 1.3 | 1.4 | 1.4 | 1.5 |
| 27 | ... | ... | 1.0 | 1.2 | 1.3 | 1.3 | 1.4 |
| 28 | ... | ... | ... | 1.1 | 1.2 | 1.2 | 1.3 |
| 29 | ... | ... | ... | 1.0 | 1.1 | 1.2 | 1.2 |

For spacings above the dotted lines the safe loads for bending are greater than the safe loads for web crippling, as explained on pages 66 to 68 inclusive.

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 9 Inch No. B 29. | | | | 10 Inch No. B 33. | | | |
| | 21 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 25 lbs. | 30 lbs. | 35 lbs. | 40 lbs. |
| 8 | 18.0 | 19.5 | 21.6 | 23.7 | ... | ... | ... | ... |
| 9 | 14.2 | 15.4 | 17.4 | 18.7 | ... | ... | ... | ... |
| 10 | 11.5 | 12.5 | 13.8 | 15.1 | 14.9 | 16.4 | 17.9 | 19.3 |
| 11 | 9.5 | 10.3 | 11.4 | 12.5 | 12.3 | 13.5 | 14.8 | 16.0 |
| 12 | 8.0 | 8.6 | 9.6 | 10.5 | 10.3 | 11.4 | 12.4 | 13.4 |
| 13 | 6.8 | 7.4 | 8.2 | 9.0 | 8.8 | 9.7 | 10.6 | 11.4 |
| 14 | 5.9 | 6.4 | 7.0 | 7.7 | 7.6 | 8.3 | 9.1 | 9.9 |
| 15 | 5.1 | 5.5 | 6.1 | 6.7 | 6.6 | 7.3 | 7.9 | 8.6 |
| 16 | 4.5 | 4.9 | 5.4 | 5.9 | 5.8 | 6.4 | 7.0 | 7.6 |
| 17 | 4.0 | 4.3 | 4.8 | 5.2 | 5.2 | 5.7 | 6.2 | 6.7 |
| 18 | 3.6 | 3.8 | 4.3 | 4.7 | 4.6 | 5.0 | 5.5 | 6.0 |
| 19 | 3.2 | 3.4 | 3.8 | 4.2 | 4.1 | 4.5 | 4.9 | 5.4 |
| 20 | 2.9 | 3.1 | 3.4 | 3.8 | 3.7 | 4.1 | 4.5 | 4.8 |
| 21 | 2.6 | 2.8 | 3.1 | 3.4 | 3.4 | 3.7 | 4.1 | 4.4 |
| 22 | 2.4 | 2.6 | 2.9 | 3.1 | 3.1 | 3.4 | 3.7 | 4.0 |
| 23 | 2.2 | 2.4 | 2.6 | 2.9 | 2.8 | 3.1 | 3.4 | 3.7 |
| 24 | 2.0 | 2.2 | 2.4 | 2.6 | 2.6 | 2.8 | 3.1 | 3.4 |
| 25 | 1.8 | 2.0 | 2.2 | 2.4 | 2.4 | 2.6 | 2.9 | 3.1 |
| 26 | 1.7 | 1.8 | 2.0 | 2.2 | 2.2 | 2.4 | 2.6 | 2.9 |
| 27 | 1.6 | 1.7 | 1.9 | 2.1 | 2.0 | 2.2 | 2.4 | 2.7 |
| 28 | 1.5 | 1.6 | 1.8 | 1.9 | 1.9 | 2.1 | 2.3 | 2.5 |
| 29 | 1.4 | 1.5 | 1.6 | 1.8 | 1.8 | 1.9 | 2.1 | 2.3 |
| 30 | 1.3 | 1.4 | 1.5 | 1.7 | 1.7 | 1.8 | 2.0 | 2.1 |
| 31 | 1.2 | 1.3 | 1.4 | 1.6 | 1.6 | 1.7 | 1.9 | 2.0 |
| 32 | ... | ... | ... | ... | 1.5 | 1.6 | 1.7 | 1.9 |
| 33 | ... | ... | ... | ... | 1.4 | 1.5 | 1.6 | 1.8 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as *follows:*

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| ance ween ports n et. | STANDARD I-BEAM. 12 Inch No. B 41. | | | SPECIAL I-BEAM. 12 Inch No. B 105. | | | |
|---|---|---|---|---|---|---|---|
| | 31.5 lbs. | 35 lbs. | 40 lbs. | 40 lbs. | 45 lbs. | 50 lbs. | 55 lbs. |
| 0 | 21.9 | 23.2 | 25.0 | 27.3 | 29.0 | 30.8 | 32.6 |
| 1 | 18.1 | 19.2 | 20.6 | 22.6 | 24.0 | 25.5 | 27.0 |
| 2 | 15.2 | 16.1 | 17.3 | 19.0 | 20.2 | 21.4 | 22.6 |
| 3 | 13.0 | 13.7 | 14.8 | 16.2 | 17.2 | 18.2 | 19.3 |
| 4 | 11.2 | 11.8 | 12.7 | 13.9 | 14.8 | 15.7 | 16.6 |
| 5 | 9.7 | 10.3 | 11.1 | 12.1 | 13.0 | 13.7 | 14.5 |
| 6 | 8.6 | 9.1 | 9.8 | 10.7 | 11.3 | 12.0 | 12.7 |
| 7 | 7.6 | 8.0 | 8.6 | 9.5 | 10.0 | 10.7 | 11.3 |
| 8 | 6.8 | 7.2 | 7.7 | 8.4 | 9.0 | 9.5 | 10.1 |
| 9 | 6.1 | 6.4 | 6.9 | 7.6 | 8.0 | 8.5 | 9.0 |
| 0 | 5.5 | 5.8 | 6.2 | 6.9 | 7.3 | 7.7 | 8.2 |
| 1 | 5.0 | 5.3 | 5.7 | 6.2 | 6.6 | 7.0 | 7.4 |
| 2 | 4.5 | 4.8 | 5.2 | 5.6 | 6.0 | 6.4 | 6.7 |
| 3 | 4.1 | 4.4 | 4.7 | 5.2 | 5.5 | 5.8 | 6.2 |
| 4 | 3.8 | 4.0 | 4.3 | 4.7 | 5.0 | 5.4 | 5.7 |
| 5 | 3.5 | 3.7 | 4.0 | 4.4 | 4.6 | 4.9 | 5.2 |
| 6 | 3.2 | 3.4 | 3.7 | 4.0 | 4.3 | 4.6 | 4.8 |
| 7 | 3.0 | 3.2 | 3.4 | 3.7 | 4.0 | 4.2 | 4.5 |
| 8 | 2.8 | 3.0 | 3.2 | 3.5 | 3.7 | 3.9 | 4.2 |
| 9 | 2.6 | 2.8 | 3.0 | 3.2 | 3.5 | 3.7 | 3.9 |
| 0 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 |
| 1 | 2.3 | 2.4 | 2.6 | 2.8 | 3.0 | 3.2 | 3.4 |
| 2 | 2.1 | 2.3 | 2.4 | 2.7 | 2.8 | 3.0 | 3.2 |
| 3 | 2.0 | 2.1 | 2.3 | 2.5 | 2.7 | 2.8 | 3.0 |
| 4 | 1.9 | 2.0 | 2.2 | 2.4 | 2.5 | 2.7 | 2.8 |
| 5 | 1.8 | 1.9 | 2.0 | 2.2 | 2.4 | 2.5 | 2.7 |
| 6 | 1.7 | 1.8 | 1.9 | 2.1 | 2.2 | 2.4 | 2.5 |

For spacings below the heavy lines the deflections will be greater than the owable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as lows:

$$\text{quired spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 15 Inch No. B 53. | | | | |
|---|---|---|---|---|---|
| | 42 lbs. | 45 lbs. | 50 lbs. | 55 lbs. | 60 lbs. |
| 10 | 35.9 | 37.0 | 39.3 | 41.5 | 43.8 |
| 11 | 29.7 | 30.6 | 32.5 | 34.3 | 36.1 |
| 12 | 24.9 | 25.7 | 27.3 | 28.8 | 30.4 |
| 13 | 21.2 | 21.9 | 23.2 | 24.6 | 25.9 |
| 14 | 18.3 | 18.9 | 20.0 | 21.2 | 22.3 |
| 15 | 16.0 | 16.5 | 17.5 | 18.5 | 19.5 |
| 16 | 14.0 | 14.5 | 15.3 | 16.2 | 17.1 |
| 17 | 12.4 | 12.8 | 13.6 | 14.4 | 15.1 |
| 18 | 11.1 | 11.4 | 12.1 | 12.8 | 13.5 |
| 19 | 9.9 | 10.3 | 10.9 | 11.5 | 12.1 |
| 20 | 9.0 | 9.3 | 9.8 | 10.4 | 10.9 |
| 21 | 8.1 | 8.4 | 8.9 | 9.4 | 9.9 |
| 22 | 7.4 | 7.7 | 8.1 | 8.6 | 9.0 |
| 23 | 6.8 | 7.0 | 7.4 | 7.9 | 8.3 |
| 24 | 6.2 | 6.4 | 6.8 | 7.2 | 7.6 |
| 25 | 5.7 | 5.9 | 6.3 | 6.6 | 7.0 |
| 26 | 5.3 | 5.5 | 5.8 | 6.1 | 6.5 |
| 27 | 4.9 | 5.1 | 5.5 | 5.7 | 6.0 |
| 28 | 4.6 | 4.7 | 5.0 | 5.3 | 5.6 |
| 29 | 4.3 | 4.4 | 4.7 | 4.9 | 5.2 |
| 30 | 4.0 | 4.1 | 4.4 | 4.6 | 4.9 |
| 31 | 3.7 | 3.9 | 4.1 | 4.3 | 4.6 |
| 32 | 3.5 | 3.6 | 3.8 | 4.1 | 4.3 |
| 33 | 3.3 | 3.4 | 3.6 | 3.8 | 4.0 |
| 34 | 3.1 | 3.2 | 3.4 | 3.6 | 3.8 |
| 35 | 2.9 | 3.0 | 3.2 | 3.4 | 3.6 |
| 36 | 2.8 | 2.9 | 3.0 | 3.2 | 3.4 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table}$$

## CING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

### SPECIAL I-BEAM.

### 15 Inch No. B 109.

| 60 lbs. | 65 lbs. | 70 lbs. | 75 lbs. | 80 lbs. |
|---|---|---|---|---|
| 49.5 | 51.7 | 53.9 | 56.2 | 58.4 |
| 40.9 | 42.7 | 44.6 | 46.4 | 48.3 |
| 34.4 | 35.9 | 37.5 | 39.0 | 40.6 |
| 29.3 | 30.6 | 31.9 | 33.2 | 34.6 |
| 25.3 | 26.4 | 27.5 | 28.7 | 29.8 |
| 22.0 | 23.0 | 24.0 | 25.0 | 26.0 |
| 19.3 | 20.2 | 21.1 | 21.9 | 22.8 |
| 17.1 | 17.9 | 18.7 | 19.4 | 20.2 |
| 15.3 | 16.0 | 16.7 | 17.3 | 18.0 |
| 13.7 | 14.3 | 14.9 | 15.6 | 16.2 |
| 12.4 | 12.9 | 13.5 | 14.0 | 14.6 |
| 11.2 | 11.7 | 12.2 | 12.7 | 13.2 |
| 10.2 | 10.7 | 11.1 | 11.6 | 12.1 |
| 9.4 | 9.8 | 10.2 | 10.6 | 11.0 |
| 8.6 | 9.0 | 9.4 | 9.8 | 10.1 |
| 7.9 | 8.3 | 8.6 | 9.0 | 9.3 |
| 7.3 | 7.6 | 8.0 | 8.3 | 8.6 |
| 6.8 | 7.1 | 7.4 | 7.7 | 8.0 |
| 6.3 | 6.6 | 6.9 | 7.2 | 7.5 |
| 5.9 | 6.1 | 6.4 | 6.7 | 6.9 |
| 5.5 | 5.7 | 6.0 | 6.2 | 6.5 |
| 5.2 | 5.4 | 5.6 | 5.8 | 6.1 |
| 4.8 | 5.0 | 5.3 | 5.5 | 5.7 |
| 4.5 | 4.7 | 5.0 | 5.2 | 5.4 |
| 4.3 | 4.5 | 4.7 | 4.9 | 5.1 |
| 4.0 | 4.2 | 4.4 | 4.6 | 4.8 |
| 3.8 | 4.0 | 4.2 | 4.3 | 4.5 |

spacings below the heavy lines the deflections will be greater than the
: limit for plastered ceilings = $\frac{1}{360}$ span.
ings for other intensities of loading may be obtained from those in tables as

$$\text{spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 15 Inch No. B 113. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 64.1 | 66.3 | 68.5 | 70.8 | 73.0 |
| 11 | 53.0 | 54.8 | 56.6 | 58.5 | 60.4 |
| 12 | 44.5 | 46.0 | 47.6 | 49.2 | 50.7 |
| 13 | 37.9 | 39.2 | 40.6 | 41.9 | 43.2 |
| 14 | 32.7 | 33.8 | 35.0 | 36.1 | 37.3 |
| 15 | 28.5 | 29.5 | 30.5 | 31.5 | 32.5 |
| 16 | 25.1 | 25.9 | 26.8 | 27.7 | 28.5 |
| 17 | 22.2 | 22.9 | 23.7 | 24.5 | 25.3 |
| 18 | 19.8 | 20.5 | 21.2 | 21.8 | 22.5 |
| 19 | 17.8 | 18.4 | 19.0 | 19.6 | 20.2 |
| 20 | 16.0 | 16.6 | 17.1 | 17.7 | 18.3 |
| 21 | 14.5 | 15.0 | 15.5 | 16.1 | 16.6 |
| 22 | 13.3 | 13.7 | 14.2 | 14.6 | 15.1 |
| 23 | 12.1 | 12.5 | 13.0 | 13.4 | 13.8 |
| 24 | 11.1 | 11.5 | 11.9 | 12.3 | 12.7 |
| 25 | 10.3 | 10.6 | 11.0 | 11.3 | 11.7 |
| 26 | 9.5 | 9.8 | 10.1 | 10.5 | 10.8 |
| 27 | 8.8 | 9.1 | 9.4 | 9.7 | 10.0 |
| 28 | 8.2 | 8.5 | 8.7 | 9.0 | 9.3 |
| 29 | 7.6 | 7.9 | 8.2 | 8.4 | 8.7 |
| 30 | 7.1 | 7.4 | 7.6 | 7.9 | 8.1 |
| 31 | 6.7 | 6.9 | 7.1 | 7.4 | 7.6 |
| 32 | 6.3 | 6.5 | 6.7 | 6.9 | 7.1 |
| 33 | 5.9 | 6.1 | 6.3 | 6.5 | 6.7 |
| 34 | 5.5 | 5.7 | 5.9 | 6.1 | 6.3 |
| 35 | 5.2 | 5.4 | 5.6 | 5.8 | 6.0 |
| 36 | 4.9 | 5.1 | 5.3 | 5.5 | 5.6 |

For spacings below the heavy lines the deflections will be greater than the allowable limit for plastered ceilings = $\frac{1}{360}$ span.

Spacings for other intensities of loading may be obtained from those in tables as *follows:*

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAMS. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 18 Inch No. B 65. | | | | 20 Inch No. B 73. | | |
| | 55 lbs. | 60 lbs. | 65 lbs. | 70 lbs. | 65 lbs. | 70 lbs. | 75 lbs. |
| 10 | 53.9 | 57.0 | 59.7 | 62.4 | 71.3 | 74.3 | 77.3 |
| 11 | 44.5 | 47.1 | 49.3 | 51.6 | 58.9 | 61.4 | 63.9 |
| 12 | 37.4 | 39.6 | 41.5 | 43.3 | 49.5 | 51.6 | 53.7 |
| 13 | 31.9 | 33.7 | 35.3 | 36.9 | 42.2 | 44.0 | 45.8 |
| 14 | 27.5 | 29.1 | 30.5 | 31.8 | 36.4 | 37.9 | 39.5 |
| 15 | 23.9 | 25.3 | 26.5 | 27.7 | 31.7 | 33.0 | 34.4 |
| 16 | 21.0 | 22.3 | 23.3 | 24.4 | 27.8 | 29.0 | 30.2 |
| 17 | 18.6 | 19.7 | 20.7 | 21.6 | 24.7 | 25.7 | 26.8 |
| 18 | 16.6 | 17.6 | 18.4 | 19.3 | 22.0 | 22.9 | 23.9 |
| 19 | 14.9 | 15.8 | 16.5 | 17.3 | 19.7 | 20.6 | 21.4 |
| 20 | 13.5 | 14.3 | 14.9 | 15.6 | 17.8 | 18.6 | 19.3 |
| 21 | 12.2 | 12.9 | 13.5 | 14.1 | 16.2 | 16.9 | 17.5 |
| 22 | 11.1 | 11.8 | 12.3 | 12.9 | 14.7 | 15.4 | 16.0 |
| 23 | 10.2 | 10.8 | 11.3 | 11.8 | 13.5 | 14.1 | 14.6 |
| 24 | 9.4 | 9.9 | 10.4 | 10.8 | 12.4 | 12.9 | 13.4 |
| 25 | 8.6 | 9.1 | 9.6 | 10.0 | 11.4 | 11.9 | 12.4 |
| 26 | 8.0 | 8.4 | 8.8 | 9.2 | 10.5 | 11.0 | 11.4 |
| 27 | 7.4 | 7.8 | 8.2 | 8.6 | 9.8 | 10.2 | 10.6 |
| 28 | 6.9 | 7.3 | 7.6 | 8.0 | 9.1 | 9.5 | 9.9 |
| 29 | 6.4 | 6.8 | 7.1 | 7.4 | 8.5 | 8.8 | 9.2 |
| 30 | 6.0 | 6.3 | 6.6 | 6.9 | 7.9 | 8.3 | 8.6 |
| 31 | 5.6 | 5.9 | 6.2 | 6.5 | 7.4 | 7.7 | 8.0 |
| 32 | 5.3 | 5.6 | 5.8 | 6.1 | 7.0 | 7.3 | 7.6 |
| 33 | 4.9 | 5.2 | 5.5 | 5.7 | 6.5 | 6.8 | 7.1 |
| 34 | 4.7 | 4.9 | 5.2 | 5.4 | 6.2 | 6.4 | 6.7 |
| 35 | 4.4 | 4.7 | 4.9 | 5.1 | 5.8 | 6.1 | 6.3 |
| 36 | 4.2 | 4.4 | 4.6 | 4.8 | 5.5 | 5.7 | 6.0 |

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required } spacing = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing from table.}$$

## SPACING OF CAMBRIA I-BEAMS FOR U FORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | SPECIAL I-BEAM. 20 Inch No. B 121. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | |
| 10 | 89.4 | 91.9 | 94.9 | 97.9 | 1( |
| 11 | 73.9 | 76.0 | 78.5 | 80.9 | |
| 12 | 62.1 | 63.9 | 65.9 | 68.0 | |
| 13 | 52.9 | 54.4 | 56.2 | 57.9 | |
| 14 | 45.6 | 46.9 | 48.4 | 50.0 | |
| 15 | 39.7 | 40.9 | 42.2 | 43.5 | |
| 16 | 34.9 | 35.9 | 37.1 | 38.3 | |
| 17 | 30.9 | 31.8 | 32.8 | 33.9 | |
| 18 | 27.6 | 28.4 | 29.3 | 30.2 | |
| 19 | 24.8 | 25.5 | 26.3 | 27.1 | |
| 20 | 22.3 | 23.0 | 23.7 | 24.5 | |
| 21 | 20.3 | 20.8 | 21.5 | 22.2 | |
| 22 | 18.5 | 19.0 | 19.6 | 20.2 | |
| 23 | 16.9 | 17.4 | 17.9 | 18.5 | |
| 24 | 15.5 | 16.0 | 16.5 | 17.0 | |
| 25 | 14.3 | 14.7 | 15.2 | 15.7 | |
| 26 | 13.2 | 13.6 | 14.0 | 14.5 | |
| 27 | 12.3 | 12.6 | 13.0 | 13.4 | |
| 28 | 11.4 | 11.7 | 12.1 | 12.5 | |
| 29 | 10.6 | 10.9 | 11.3 | 11.6 | |
| 30 | 9.9 | 10.2 | 10.5 | 10.9 | |
| 31 | 9.3 | 9.6 | 9.9 | 10.2 | |
| 32 | 8.7 | 9.0 | 9.3 | 9.6 | |
| 33 | 8.2 | 8.4 | 8.7 | 9.0 | |
| 34 | 7.7 | 8.0 | 8.2 | 8.5 | |
| 35 | 7.3 | 7.5 | 7.7 | 8.0 | |
| 36 | 6.9 | 7.1 | 7.3 | 7.6 | |

Spacings for other intensities of loading may be obtained from those in t
*follows:*

$$\textit{Required spacing} = \frac{\text{Intensity of loading from table}}{\text{New intensity of loading}} \times \text{Computed spacing fro}$$

## SPACING OF CAMBRIA I-BEAMS FOR UNIFORM LOAD OF 175 LBS. PER SQUARE FOOT.

Proper distance in feet, center to center of Beams.
Maximum fibre stress 16 000 pounds per square inch.

| Distance between supports in feet. | STANDARD I-BEAM. 24 Inch No. B 89. | | | | |
|---|---|---|---|---|---|
| | 80 lbs. | 85 lbs. | 90 lbs. | 95 lbs. | 100 lbs. |
| 10 | 106.0 | 110.1 | 113.7 | 117.3 | 120.9 |
| 11 | 87.6 | 91.0 | 94.0 | 96.9 | 99.9 |
| 12 | 73.6 | 76.5 | 79.0 | 81.4 | 83.9 |
| 13 | 62.7 | 65.2 | 67.3 | 69.4 | 71.5 |
| 14 | 54.1 | 56.2 | 58.0 | 59.8 | 61.7 |
| 15 | 47.1 | 48.9 | 50.5 | 52.1 | 53.7 |
| 16 | 41.4 | 43.0 | 44.7 | 45.8 | 47.2 |
| 17 | 36.7 | 38.1 | 39.3 | 40.6 | 41.8 |
| 18 | 32.7 | 34.0 | 35.1 | 36.2 | 37.3 |
| 19 | 29.4 | 30.5 | 31.5 | 32.5 | 33.5 |
| 20 | 26.5 | 27.5 | 28.4 | 29.3 | 30.2 |
| 21 | 24.0 | 25.0 | 25.8 | 26.6 | 27.4 |
| 22 | 21.9 | 22.8 | 23.5 | 24.2 | 25.0 |
| 23 | 20.0 | 20.8 | 21.5 | 22.2 | 22.8 |
| 24 | 18.4 | 19.1 | 19.7 | 20.4 | 21.0 |
| 25 | 17.0 | 17.6 | 18.2 | 18.8 | 19.3 |
| 26 | 15.7 | 16.3 | 16.8 | 17.3 | 17.9 |
| 27 | 14.5 | 15.1 | 15.6 | 16.1 | 16.6 |
| 28 | 13.5 | 14.0 | 14.5 | 15.0 | 15.4 |
| 29 | 12.6 | 13.1 | 13.5 | 13.9 | 14.4 |
| 30 | 11.8 | 12.2 | 12.6 | 13.0 | 13.4 |
| 31 | 11.0 | 11.5 | 11.8 | 12.2 | 12.6 |
| 32 | 10.4 | 10.8 | 11.1 | 11.5 | 11.8 |
| 33 | 9.7 | 10.1 | 10.4 | 10.8 | 11.1 |
| 34 | 9.2 | 9.5 | 9.8 | 10.1 | 10.5 |
| 35 | 8.7 | 9.0 | 9.3 | 9.6 | 9.9 |
| 36 | 8.2 | 8.5 | 8.8 | 9.0 | 9.3 |

For spacings above the dotted lines the safe loads for bending are greater than the safe loads for web crippling, as explained on pages 66 to 68 inclusive.

Spacings for other intensities of loading may be obtained from those in tables as follows:

$$\text{Required } \textit{spacing} = \frac{\textit{Intensity of loading} \text{ from table}}{\textit{New intensity of loading}} \times \text{Computed spacing from table.}$$

# GENERAL FORMULÆ FOR FLEXURE OF BEAMS.

## NOTATION.

A = Area of Section in square inches.
d = Depth of Cross Section in inches.
l = Length of Span in inches.
L = Length of Span in feet.
p = Stress in extreme fibre of section in pounds per square inch.
$X_1$ = Distance of Center of Gravity of Section from extreme fibre in inches.
W = Total Load, in pounds, Uniformly Distributed, including the Weight of Beam.
$W_1$ = Total Superimposed or Live Load, in pounds, Uniformly Distributed.
$W_2$ = Total Weight of Beam, in pounds, Uniformly Distributed.
$W_s$ = Total Safe Load, in pounds, Uniformly Distributed.
P = Load, in pounds, concentrated at any point.
F = Coefficient of Strength of the Tables of Properties = Safe Load, in pounds, for a fibre stress of 16 000 pounds per square inch for a span of one foot.
F′ = Coefficient of Strength of the Tables of Properties = Safe Load, in pounds, for a fibre stress of 12 500 pounds per square inch for a span of one foot.
D = Total Deflection of Beam, in inches, due to weight W.
$Dw_1$ and $D_p$ = Deflections of Beams, in inches, due to the weights $W_1$ and P respectively.
N = Coefficient of Deflection of the Tables of Properties = Deflection, in inches, due to a total load of 1 000 pounds uniformly distributed for a span of one foot.
N′ = Coefficient of Deflection of the Tables of Properties = Deflection, in inches, due to a superimposed load of 1 000 pounds, concentrated at the middle of a Beam with a span of one foot.
H = Coefficient of Deflection, in inches, for fibre stress of 16 000 pounds per square inch, for any section used as a Beam subjected to its safe load Uniformly Distributed. (See table, page 70.)
H′ = Coefficient of Deflection, in inches, for fibre stress of 12 500 pounds per square inch for any section used as a Beam subjected to its safe load Uniformly Distributed. (See table, page 70.)
M = Total Bending Moment, in inch pounds, due to the Weight of Beam and Superimposed Load.
I = Moment of Inertia, in inches$^4$, Axis through Center of Gravity.
$I_1$ = Moment of Inertia, in inches$^4$ Axis parallel to above but not through Center of Gravity.
v = Distance, in inches, between these Axes.
S = Section Modulus in inches$^3$.
r = Radius of Gyration in inches.
E = Modulus of Elasticity, in pounds, per square inch (Steel = 29 000 000).

## GENERAL FORMULÆ.

$$S = \frac{I}{X_1} \qquad I_1 = I + Av^2 \qquad r = \sqrt{\frac{I}{A}}$$

$$M = \frac{pI}{X_1} = pS \quad \therefore \quad p = \frac{MX_1}{I} = \frac{M}{S}. \quad \text{Or for Symmetrical Section } M = \frac{2pI}{d}$$

For Beam supported at both ends and Uniformly Loaded:

$$M = \frac{Wl}{8} = \frac{(W_1 + W_2)\,l}{8} \quad \therefore \quad W = (W_1 + W_2) = \frac{8M}{l} = \frac{8pI}{lX_1} = \frac{8pS}{l}$$

## SAFE LOADS.

$$F = \frac{8pS}{l} \text{ where } p = 16\,000 \text{ pounds and } l = 12'' \text{ therefore } F = \frac{2}{3}\,16\,000\,S$$

$$F' = \frac{8pS}{l} \text{ where } p = 12\,500 \text{ pounds and } l = 12'' \text{ therefore } F' = \frac{2}{3}\,12\,500\,S$$

To obtain the Safe Load for any span in feet, for fibre stress of 16 000 pounds per square inch:

$$\text{Safe Load} = W_s = \frac{2}{3}\,\frac{16\,000\,S}{L} = \frac{F}{L}$$

To obtain the Safe Load for any span in feet, for fibre stress of 12 500 pounds per square inch:

$$\text{Safe Load} = W_s = \frac{2}{3}\,\frac{12\,500\,S}{L} = \frac{F'}{L}$$

# GENERAL FORMULÆ FOR FLEXURE OF BEAMS. Continued.

## DEFLECTIONS.

(1) Beam supported at both ends and Uniformly Loaded:

$$\text{Deflection for Total Load} = D = \frac{5}{384}\frac{Wl^3}{EI} = \frac{5}{384}\frac{(W_1 + W_2)\,l^3}{EI}$$

$$\text{Deflection for Superimposed Load} = Dw_1 = \frac{5}{384}\frac{W_1 l^3}{EI}$$

(2) Beam supported at both ends with load concentrated at the middle:

$$\text{Deflection for Total Load} = D = \frac{Pl^3}{48EI} + \frac{5}{384}\frac{W_2 l^3}{EI}$$

$$\text{Deflection for Superimposed Load} = D_p = \frac{Pl^3}{48EI}$$

(3) Beam fixed at one end, unsupported at the other, and Uniformly Loaded:

$$\text{Deflection for Total Load} = D = \frac{Wl^3}{8EI} = \frac{(W_1 + W_2)\,l^3}{8EI}$$

$$\text{Deflection for Superimposed Load} = Dw_1 = \frac{W_1 l^3}{8EI}$$

(4) Beam fixed at one end, and unsupported at the other, with load concentrated at the unsupported end:

$$\text{Deflection for Total Load} = D = \frac{Pl^3}{3EI} + \frac{W_2 l^3}{8EI}$$

$$\text{Deflection for Superimposed Load} = D_p = \frac{Pl^3}{3EI}$$

$N = \frac{5}{384}\frac{Wl^3}{EI} = \frac{5}{384}\frac{(W_1 + W_2)\,l^3}{EI}$, where $W = (W_1 + W_2) = 1\,000$ pounds and $l = 12''$

$N' = \frac{Pl^3}{48EI}$, where $P = 1\,000$ pounds and $l = 12''$

Total Deflection, in inches, due to a Beam Uniformly Loaded for any span in feet $= D = \frac{NWL^3}{1\,000} = \frac{N\,(W_1 + W_2)\,L^3}{1\,000}$

Total Deflection, in inches, due to a Superimposed Load P and the Weight of Beam $W_2$ for any span in feet $= D = \frac{N'PL^3}{1\,000} + \frac{NW_2L^3}{1\,000}$

$$H = \frac{12}{725}L^3 \qquad H' = \frac{8}{232}L^3$$

## FOR SYMMETRICAL SECTIONS.

Total Deflection, in inches, for a fibre stress of 16 000 lbs. per square inch $= D = \frac{H}{d}$

Total Deflection, in inches, for a fibre stress of 12 500 lbs. per square inch $= D = \frac{H'}{d}$

## FOR UNSYMMETRICAL SECTIONS.

Total Deflection, in inches, for a fibre stress of 16 000 pounds per square inch $= D = \frac{H}{2X_1}$

Total Deflection, in inches, for a fibre stress of 12 500 pounds per square inch $= D = \frac{H'}{2X_1}$

# BENDING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTION.

$W$ = Total Load, in lbs., uniformly distributed, including the weight of beam.

$W_1$ = Total Superimposed or Live Load, in lbs., uniformly distributed.

$W_2$ = Total Weight of Beam or Dead Load, in lbs., uniformly distributed.

$P$, $P_1$, $P_2$, $P_3$ = Loads, in lbs., concentrated at any points.

$M$ = Total Bending Moment, in inch-lbs.

$M_{w1}$, $M_p$ = Bending Moments, in inch-lbs., due to Weights $W_1$ and $P$ respectively.

$I$ = Moment of Intertia, in inches$^4$.

$l$ = Length of Span, in inches.

$E$ = Modulus of Elasticity, in lbs. per square inch = 29 000 000 for steel.

$W_s$ = Total Safe Load, in lbs., uniformly distributed, including weight of beam = Total Safe Load of Tables.

The ordinates in diagrams give the bending moments for corresponding points on beam. For superimposed load only, make $W_2$ in formulæ equal to zero.

## (1) Beam Supported at both ends and Uniformly Loaded.

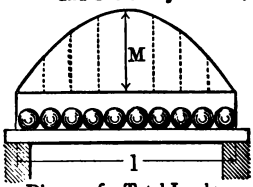



Diagram for Total Load :—

Draw parabola having $M = \frac{Wl}{8}$

Safe Superimposed Load, in lbs., uniformly distributed, $W'_s = W_s - W_2$.

Maximum Bending Moment at middle of beam $= M = \frac{Wl}{8} = \frac{(W_1 + W_2)\,l}{8}$.

Maximum Shear at points of support $= \frac{W}{2} = \frac{W_1 + W_2}{2}$.

Maximum Deflection $= \frac{5}{384}\,\frac{Wl^3}{EI} = \frac{5}{384}\,\frac{(W_1 + W_2)\,l^3}{EI}$.

## (2) Beam Supported at both ends with Load Concentrated at the Middle.

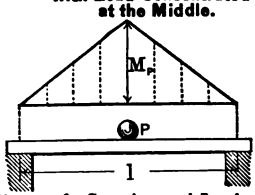



Diagram for Superimposed Load :—

Draw triangle having $M_p = \frac{Pl}{4}$

Diagram for Dead Load similar to Case(1)

Safe Superimposed Load, in lbs., concentrated, $P_s = \frac{W_s - W_2}{2}$.

Maximum Bending Moment at middle of beam $= M = \frac{Pl}{4} + \frac{W_2\,l}{8}$.

Maximum Shear at points of support $= \frac{P + W_2}{2}$.

Max. Deflection $= \frac{Pl^3}{48EI} + \frac{5}{384}\,\frac{W_2\,l^3}{EI}$.

## (3) Beam fixed at one end, Unsupported at the other and Uniformly Loaded.

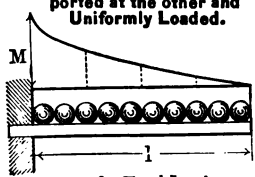



*Diagram* for Total Load :—

*Draw Parabola* having $M = \frac{Wl}{2}$

Safe Superimposed Load, in lbs., uniformly distributed, $W'_s = \frac{W_s}{4} - W_2$.

Maximum Bending Moment at point of support $= \frac{Wl}{2} = \frac{(W_1 + W_2)\,l}{2}$.

Maximum Shear at point of support $= W = W_1 + W_2$.

Max. Deflection $= \frac{Wl^3}{8EI} = \frac{(W_1 + W_2)\,l^3}{8EI}$.

# ING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTION.

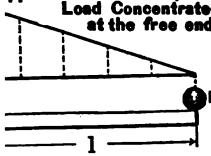
'otal Load, in lbs., uniformly d, including the weight of

Total Superimposed or Live lbs., uniformly distributed.
Total Weight of Beam or ad, in lbs., uniformly dis-

$P_2$, $P_3$ = Loads, in lbs., con- at any points.
dinates in diagrams give the

M = Total Bending Moment, in inch-lbs.
$M_{w1}, M_p$ = Bending Moments, in inch-lbs., due to Weights $W_1$ and P respectively.
I = Moment of Inertia, in inches$^4$.
l = Length of Span, in inches.
E = Modulus of Elasticity, in lbs. per square inch = 29 000 000 for steel.
$W_1$ = Total Safe Load, in lbs., uniformly distributed, including weight of beam = Total Safe Load of Tables.
bending moments for corresponding points
For superimposed load only, make $W_2$ in formulæ equal to zero.

## m fixed at one end, and Unpported at the other, with Load Concentrated at the free end.




for Superimposed Load:—
triangle having $M_p = Pl$.
or Dead Load similar to Case (3)

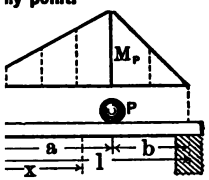
Safe Superimposed Load, in lbs., concentrated, $P_s = \frac{W_s - 4W_2}{8}$.

Maximum Bending Moment at point of support = $Pl + \frac{W_2 l}{2}$.

Maximum Shear at point of support = $P + W_2$.

Maximum Deflection = $\frac{Pl^3}{3EI} + \frac{W_2 l^3}{8EI}$.

## im Supported at both ends ith Load Concentrated at ny point.




for Superimposed Load:—
triangle having $M_p = \frac{Pab}{l}$.
m for Dead Load similar to

Safe Superimposed Load, in lbs., concentrated, $P_s = \frac{W_s l^3 - 4a W_2 (l - a)}{8ab}$.

Maximum Bending Moment under load = $\frac{a(2Pb + W_2 l - W_2 a)}{2l}$.

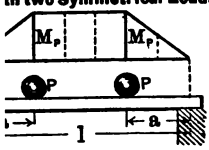
Max. Shear at Sup. near a = $\frac{Pb}{l} + \frac{W_2}{2}$.

Max. Shear at Sup. near b = $\frac{Pa}{l} + \frac{W_2}{2}$.

Deflection at distance x from left support = $\frac{1}{3lEI}\left[\frac{2al - a^2}{3}\right]^{\frac{3}{2}}$
$\left[Pb + \frac{W_2}{8}\left(2l - \sqrt{\frac{2al - a^2}{3}} - \frac{3l^3}{2al - a^2}\right)\right]$

$x = \sqrt{\frac{2al - a^2}{3}}$ = Distance, from left support, of point of maximum deflection for superimposed load.

## im Supported at both ends th two Symmetrical Loads.




n for Superimposed Load:—
trapezoid having $M_p = Pa$.
*or Dead Load similar to Case (1)*

Safe Superimposed Load, in lbs., concentrated, each, $P_s = \frac{W_s l - W_2 l}{8a}$.

Maximum Bending Moment at center of beam = $Pa + \frac{W_2 l}{8}$.

Maximum Shear at points of support = $\frac{2P + W_2}{2}$.

Maximum Deflection = $\frac{Pa}{24EI}\left(3l^2 - 4a^2\right) + \frac{5}{384}\frac{W_2 l^3}{EI}$.

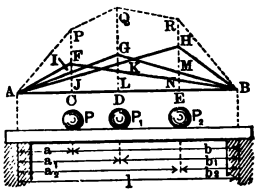
# BENDING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTION.

W = Total Load, in lbs., uniformly distributed, including the weight of beam.
$W_1$ = Total Superimposed or Live Load, in lbs., uniformly distributed.
$W_2$ = Total Weight of Beam or Dead Load, in lbs., uniformly distributed.
P, $P_1$, $P_2$, $P_3$ = Loads, in lbs., concentrated at any points.

M = Total Bending Moment, in inch-lbs.
$M_{w1}$, $M_p$ = Bending Moments, in inch-lbs., due to Weights $W_1$ and P respectively.
I = Moment of Inertia, in inches$^4$.
l = Length of Span, in inches.
E = Modulus of Elasticity, in lbs., per square inch = 29 000 000 for steel.
$W_t$ = Total Safe Load, in lbs., uniformly distributed, including the weight of beam = Total Safe Load of Tables.

The ordinates in diagrams give the bending moments for corresponding points on beam. For superimposed load only, make $W_2$ in formulæ equal to zero.

## (7) Beam Supported at both ends with Loads Concentrated at various Points.




The total bending moment at any point produced by all the weights is equal to the sum of the moments at that point produced by each of the weights separately.

Diagram for Dead Load similar to Case (1)

The Maximum Bending Moment occurs at the point where the vertical shear equals zero and will be at one of the loads P, $P_1$, or $P_2$ depending upon their amounts and spacing if $W_2$ is neglected.

Let R = Reaction at Left Support.

Bending Moment at P =

$$M_p = Ra - \frac{W_2 a^2}{2l}.$$

Bending Moment at $P_1$ =

$$M_{p1} = Ra_1 - \left[\frac{W_2 a_1^2}{2l} + P(a_1 - a)\right].$$

Bending Moment at $P_2$ = $M_{p2} = Ra_2 -$

$$\left[\frac{W_2 a_2^2}{2l} + P_1(a_2 - a_1) + P(a_2 - a)\right].$$

Shear or Reaction at Left Support =

$$\frac{P_2 b_2 + P_1 b_1 + Pb}{l} + \frac{W_2}{2}.$$

Shear or Reaction at Right Support =

$$\frac{P_2 a_2 + P_1 a_1 + Pa}{l} + \frac{W_2}{2}.$$

Diagram for Superimposed Load:— Draw as in Case (5) the Ordinates FC, GD and HE representing the bending moments due to loads P, $P_1$ and $P_2$ respectively. Produce FC to P, making PC = FC + IC + JC; GD to Q, making QD = GD + KD + LD; and HE to R, making RE = HE + ME + NE. Join the points A, P, Q, R and B, then the ordinates between A B and polygon A P Q R B will represent the bending moment for corresponding points on beam.

# BENDING MOMENTS AND DEFLECTIONS FOR BEAMS OF UNIFORM SECTION.

W = Total Load, in lbs., uniformly distributed, including the weight of beam.

$W_1$ = Total Superimposed or Live Load, in lbs., uniformly distributed.

$W_2$ = Total Weight of Beam or Dead Load, in lbs., uniformly distributed.

$P, P_1, P_2, P_3$ = Loads, in lbs., concentrated at any points.

M = Total Bending Moment, in inch-lbs.

$M_{w1}, M_p$ = Bending Moments, in inch-lbs., due to Weights $W_1$ and P respectively.

I = Moment of Inertia, in inches$^4$.

l = Length of Span, in inches.

E = Modulus of Elasticity, in lbs., per square inch = 29 000 000 for steel.

$W_s$ = Total Safe Load, in lbs., uniformly distributed, including the weight of beam = Total Safe Load of Tables.

The ordinates in diagrams give the bending moments for corresponding points on beam. For superimposed load only, make $W_2$ in formulæ equal to zero.

## (8) Beam Fixed at both ends and Uniformly Loaded.

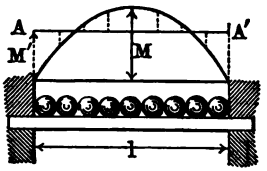



Diagram for Total Load:—Draw parabola having $M = \frac{Wl}{8}$. Also A A′ parallel to base and at a distance $M' = \frac{Wl}{12}$. The Vertical distances between the parabola and line A A′ are the moments for corresponding points on beam.

Safe Superimposed Load, in lbs., uniformly distributed, $W'_s = \frac{3}{4} W_s - W_2$.

Distance of points of contra-flexure from supports = .2113l.

Maximum Bending Moment at points of support $= \frac{Wl}{12} = \frac{(W_1 + W_2)\,l}{12}$.

Bending Moment at middle of beam $= \frac{Wl}{24} = \frac{(W_1 + W_2)\,l}{24}$.

Maximum Shear at points of support $= \frac{W_1 + W_2}{2}$.

Maximum Deflection $= \frac{Wl^3}{384EI} = \frac{(W_1 + W_2)\,l^3}{384EI}$

## (9) Beam Fixed at both ends with Load Concentrated at the Middle.

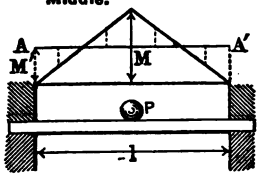



Diagram for Superimposed Load:—Draw triangle having $M = \frac{Pl}{4}$. Also A A′ parallel to base and at a distance $M' = \frac{Pl}{8}$. The Vertical distances between the triangle and line A A′ are the moments for corresponding points on beam.

Diagram for Dead Load similar to Case (8)

Safe Superimposed Load, in lbs., concentrated, $P_s = W_s - \frac{1}{2} W_2$.

Distance of points of contra-flexure from supports = $\frac{1}{4}$l.

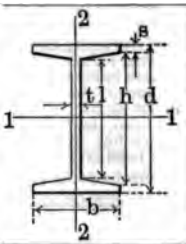
Maximum Bending Moment at points of support $= \frac{Pl}{8} + \frac{W_2 l}{12}$.

Bending Moment at middle of beam $= \frac{Pl}{8} + \frac{W_2 l}{24}$.

Maximum Shear at points of support $= \frac{P + W_2}{2}$.

Maximum Deflection $= \frac{Pl^3}{192EI} + \frac{W_2 l^3}{384EI}$.

# VALUES OF MOMENTS OF INERTIA FOR STAI ARD AND CAMBRIA SECTIONS.



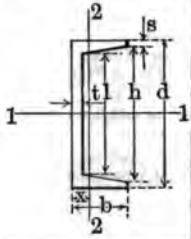

$$A = td + 2s\,(b-t) + \frac{(b-t)^2}{12}.$$

$$I, \text{ Axis } 1-1 = \frac{bd^3}{12} - \frac{h^4-l^4}{8}.$$

$$I', \text{ Axis } 2-2 = \frac{b^3s}{6} + \frac{lt^3}{12} + \frac{b^4-t^4}{288}.$$

$$\text{Slope of flange} = g = \frac{h-l}{b-t} = \frac{1}{6} \text{ for standard sectio}$$

$$h = d - 2s. \qquad l = h - g(b-t).$$




$$A = td + 2s\,(b-t) + \frac{(b-t)^2}{6}.$$

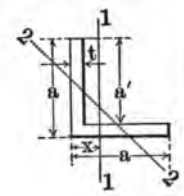
$$x = \left[b^2s + \frac{ht^2}{2} + \frac{(b-t)^2\,(b+2t)}{18}\right] \div A.$$

$$I, \text{ Axis } 1-1 = \frac{bd^3}{12} - \frac{h^4-l^4}{16}.$$

$$I', \text{ Axis } 2-2 = \frac{1}{3}\left[2sb^3 + lt^3 + \frac{b^4-t^4}{12}\right] - Ax^2.$$

$$\text{Slope of flange} = g = \frac{h-l}{2(b-t)} = \frac{1}{6} \text{ for standard sec}$$

$$h = d - 2s. \qquad l = h - 2g(b-t).$$

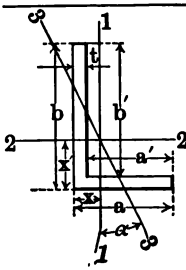



$$A = t\,(2a - t).$$

$$x = \frac{a^2+at-t^2}{2(2a-t)}.$$

$$I, \text{ Axis } 1-1 = \frac{t(a-x)^3+ax^3-(a-t)\,(x-t)^3}{3}$$

$$I'', \text{ Axis } 2-2 = \frac{2x^4-2(x-t)^4+t\left[a-\left(2x-\frac{t}{2}\right)\right]}{3}$$




$$A = t(a + b - t).$$

$$x = \frac{t(2a'+b)+a'^2}{2(a'+b)}. \qquad x' = \frac{t(2b'+a)+b'^2}{2(b'+a)}.$$

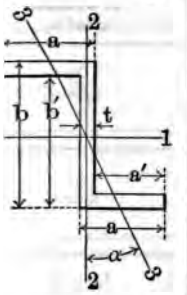
$$\text{Tan. } 2\alpha = -\frac{[(2x-t)b(b-2x')+(2x'-t)(a-t)(a+t-2}{2(I'-I)}$$

$$I, \text{ Axis } 1-1 = \frac{t(a-x)^3+bx^3-(b-t)(x-t)^3}{3}.$$

$$I', \text{ Axis } 2-2 = \frac{t(b-x')^3+ax'^3-(a-t)(x'-t)^3}{3}$$

$$I'', \text{ Axis } 3-3 = \frac{I\cos^2\alpha - I'\sin^2\alpha}{\cos 2\alpha}.$$

# LUES OF MOMENTS OF INERTIA FOR STANDARD AND CAMBRIA SECTIONS.



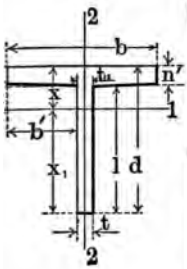

$$A = [b + 2(a - t)]\, t.$$

$$\text{Tan. } 2\alpha = -\frac{(bt - t^2)(a^2 - at)}{I - I'}.$$

$$I, \text{ Axis } 1-1 = \frac{ab^3 - a'(b-2t)^3}{12}.$$

$$I', \text{ Axis } 2-2 = \frac{b(a+a')^3 - 2a'^3b' - 6a'a^2b'}{12}.$$

$$I'' \text{ Minimum, Axis } 3-3 = \frac{I' \cos^2\alpha - I \sin^2\alpha}{\cos 2\alpha}.$$

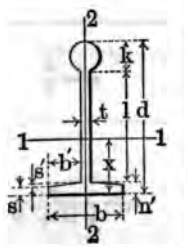



$$A = \frac{l(t+t_1)}{2} + n' t_1 + b'(s + n').$$

$$x = \frac{3s^2(b-t_1) + 2b's'(s'+3s) + 3t_1d^2 - l(t_1-t)(3d-l)}{6A}.$$

$$I, \text{ Axis } 1-1 = \frac{l^3(3t+t_1) + 4bn'^3 - 2b's'^3}{12} - A(x-n')^2$$

$$I', \text{ Axis } 2-2 = \frac{sb^3 + s't_1^3 + lt^3}{12} + \frac{s'b'[2b'^2 + (2b'+3t_1)^2]}{36} + \frac{l(t_1-t)[(t_1-t)^2 + 2(t_1+2t)^2]}{144}.$$




$e$ = Area of head.

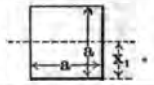
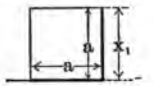
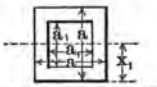
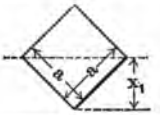
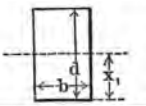
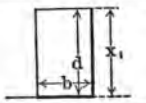
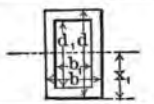
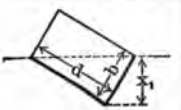
$$A = e + t(d-k) + (b-t)\left(s + \frac{s'}{2}\right).$$

$$x = \frac{e(2d-k) + t(d-k)^2 + (b-t)\left(s^2 + ss' + \frac{s'^2}{3}\right)}{2A}.$$

$$I, \text{ Axis } 1-1 = e\left[\frac{k^2}{16} + \left(d - \frac{2s+k}{2}\right)^2\right] + \frac{t(l+s')^3}{3} + \frac{b's'^3 + 2bs^3}{6} - A(x-s)^2.$$

$$I', \text{Axis } 2-2 = \frac{ek^2}{16} + \frac{t^3(l+s') + sb^3}{12} + \frac{s'b'[2b'^2 + (2b'+3t_1)^2]}{36}$$

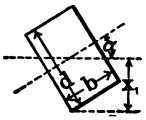
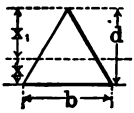
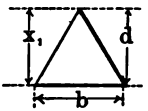
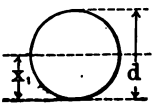
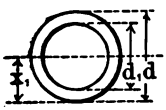
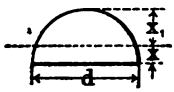
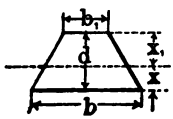
## PROPERTIES OF VARIOUS SECTIONS.

| Sections. | Area of Section. A | Distance from Neutr Axis to Extremities of Section. x and $x_1$ |
|---|---|---|
|  | $a^2$ | $x_1 = \frac{a}{2}$ |
|  | $a^2$ | $x_1 = a$ |
|  | $a^2 - a_1^2$ | $x_1 = \frac{a}{2}$ |
|  | $a^2$ | $x_1 = \frac{a}{\sqrt{2}} = .707a$ |
|  | bd | $x_1 = \frac{d}{2}$ |
|  | bd | $x_1 = d$ |
|  | $bd - b_1d_1$ | $x_1 = \frac{d}{2}$ |
|  | bd | $x_1 = \frac{b\,d}{\sqrt{b^2 + d^2}}$ |

## PROPERTIES OF VARIOUS SECTIONS.

| Moment of Inertia. $I$ | Section Modulus. $S = \frac{I}{x_1}$. | Radius of Gyration. $r = \sqrt{\frac{I}{A}}$. |
|---|---|---|
| $\frac{a^4}{12}$ | $\frac{a^3}{6}$ | $\frac{a}{\sqrt{12}} = .289a$ |
| $\frac{a^4}{3}$ | $\frac{a^3}{3}$ | $\frac{a}{\sqrt{3}} = .577a$ |
| $\frac{a^4 - a_1^4}{12}$ | $\frac{a^4 - a_1^4}{6a}$ | $\sqrt{\frac{a^2 + a_1^2}{12}}$ |
| $\frac{a^4}{12}$ | $\frac{a^3}{6\sqrt{2}} = .118a^3$ | $\frac{a}{\sqrt{12}} = .289a$ |
| $\frac{bd^3}{12}$ | $\frac{bd^2}{6}$ | $\frac{d}{\sqrt{12}} = .289d$ |
| $\frac{bd^3}{3}$ | $\frac{bd^2}{3}$ | $\frac{d}{\sqrt{3}} = .577d$ |
| $\frac{bd^3 - b_1d_1^3}{12}$ | $\frac{bd^3 - b_1d_1^3}{6d}$ | $\sqrt{\frac{bd^3 - b_1d_1^3}{12(bd - b_1d_1)}}$ |
| $\frac{b^3d^3}{6(b^2 + d^2)}$ | $\frac{b^2d^2}{6\sqrt{b^2 + d^2}}$ | $\frac{bd}{\sqrt{6(b^2 + d^2)}}$ |

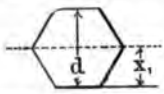
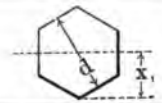
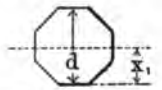
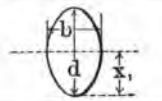
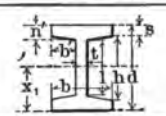
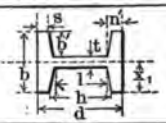
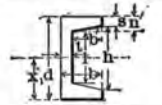
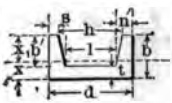
## PROPERTIES OF VARIOUS SECTIONS.

| Sections. | Area of Section. A | Distance from Neutr Axis to Extremities of Section. x and $x_1$ |
|---|---|---|
|  | bd | $x_1 = \frac{d\cos\alpha + b\sin\alpha}{2}$ |
|  | $\frac{bd}{2}$ | $x = \frac{d}{3}$<br>$x_1 = \frac{2d}{3}$ |
|  | $\frac{bd}{2}$ | $x_1 = d$ |
|  | $\frac{\pi d^2}{4} = .785d^2$ | $x_1 = \frac{d}{2}$ |
|  | $\frac{\pi(d^2 - d_1^2)}{4} = .785(d^2 - d_1^2)$ | $x_1 = \frac{d}{2}$ |
|  | $\frac{\pi d^2}{8} = .393d^2$ | $x = \frac{2d}{3\pi} = .212d$<br>$x_1 = \frac{(3\pi - 4)d}{6\pi} = .288$ |
|  | $\frac{b + b_1}{2} \cdot d$ | $x = \frac{b + 2b_1}{b + b_1} \cdot \frac{d}{3}$<br>$x_1 = \frac{b_1 + 2b}{b + b_1} \cdot \frac{d}{3}$ |

## PROPERTIES OF VARIOUS SECTIONS.

| Moment of Inertia. I | Section Modulus. $S = \frac{I}{x_1}$. | Radius of Gyration. $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|
| $\frac{bd}{12}\ (d^2\cos^2\alpha + b^2\sin^2\alpha)$ | $\frac{db}{6}\left(\frac{d^2\cos^2\alpha + b^2\sin^2\alpha}{d\cos + b\sin\alpha}\right)$ | $\sqrt{\frac{d^2\cos^2\alpha + b^2\sin^2\alpha}{12}}$ |
| $\frac{bd^3}{36}$ | $\frac{bd^2}{24}$ | $\frac{d}{\sqrt{18}} = .236d$ |
| $\frac{bd^3}{12}$ | $\frac{bd^2}{12}$ | $\frac{d}{\sqrt{6}} = .408d$ |
| $\frac{\pi d^4}{64} = .049d^4$ | $\frac{\pi d^3}{32} = .098d^3$ | $\frac{d}{4}$ |
| $\frac{\pi(d^4 - d_1^4)}{64} = .049\,(d^4 - d_1^4)$ | $\frac{\pi}{32}\frac{(d^4 - d_1^4)}{d} = .098\frac{(d^4 - d_1^4)}{d}$ | $\frac{\sqrt{d^2 + d_1^2}}{4}$ |
| $\frac{9\pi^2 - 64}{1152\pi}\cdot d^4 = .007d^4$ | $\frac{9\pi^2 - 64}{192\,(3\pi - 4)}\cdot d^3 = .024d^3$ | $\frac{\sqrt{9\pi^2 - 64}}{12\pi}\cdot d = .132d$ |
| $\frac{b^2 + 4bb_1 + b_1^2}{36\,(b + b_1)}\cdot d^3$ | $\frac{b^2 + 4bb_1 + b_1^2}{12\,(b_1 + 2b)}\cdot d^2$ | $\frac{d}{6(b+b_1)}\sqrt{2(b^2+4bb_1+b_1^2)}$ |

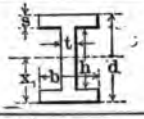
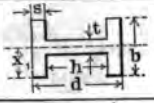
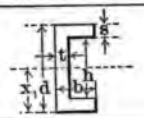
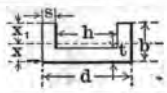
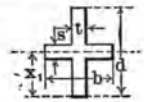
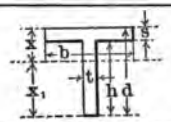
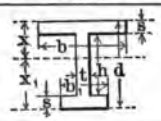
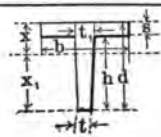
## PROPERTIES OF VARIOUS SECTIONS.

| Sections. | Area of Section. A | Distance from Neut Axis to Extremities of Section. x and $x_1$ |
|---|---|---|
|  | $\frac{3}{2} d^2 \tan. 30^\circ = .866d^2$ | $x_1 = \frac{d}{2}$ |
|  | $\frac{3}{2} d^2 \tan. 30^\circ = .866d^2$ | $x_1 = \frac{d}{2 \cos 30^\circ} = .577$ |
|  | $2d^2 \tan. 22\frac{1}{2}^\circ = .828d^2$ | $x_1 = \frac{d}{2}$ |
|  | $\frac{\pi bd}{4} = .785\ bd$ | $x_1 = \frac{d}{2}$ |
|  | $td + 2b'(s + n')$ | $x_1 = \frac{d}{2}$ |
|  | $td + 2b'(s + n')$ | $x_1 = \frac{b}{2}$ |
|  | $td + b'(s + n')$ | $x_1 = \frac{d}{2}$ |
|  | $td + b'(s + n')$ | $x = [b^2 s + \frac{ht^2}{2} + \frac{g}{3}(b-$ $(b + 2t)] \div A$ $x_1 = b - x$ |

## PROPERTIES OF VARIOUS SECTIONS.

| ment of Inertia. I | Section Modulus. $S = \frac{I}{x_1}$ | Radius of Gyration. $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|
| $\frac{(1 + 2\cos^2 30°)}{4\cos^2 30°}\Big] = .06d^4$ | $\frac{A}{6}\left[\frac{d(1+2\cos^2 30°)}{4\cos^2 30°}\right] = .12d^3$ | $\frac{d}{4\cos 30°}\sqrt{\frac{1+2\cos^2 30°}{3}} = .264d$ |
| $\frac{(1 + 2\cos^2 30°)}{4\cos^2 30°}\Big] = .06d^4$ | $\frac{A}{6}\left[\frac{d(1 + 2\cos^2 30°)}{4\cos 30°}\right] = .104d^3$ | $\frac{d}{4\cos 30°}\sqrt{\frac{1+2\cos^2 30°}{3}} = .264d$ |
| $\frac{(1 + 2\cos^2 22\frac{1}{2}°)}{4\cos^2 22\frac{1}{2}°}\Big] = .055d^4$ | $\frac{A}{6}\left[\frac{d(1 + 2\cos^2 22\frac{1}{2}°)}{4\cos 22\frac{1}{2}°}\right] = .109d^3$ | $\frac{d}{4\cos 22\frac{1}{2}°}\sqrt{\frac{1+2\cos^2 22\frac{1}{2}°}{3}} = .257d$ |
| $\frac{\pi bd^3}{64} = .049bd^3$ | $\frac{\pi bd^2}{32} = .098bd^2$ | $\frac{d}{4}$ |
| $d^3 - \frac{1}{4g}(h^4 - l^4)\Big]$ | $\frac{2I}{d}$ | $r = \sqrt{\frac{I}{A}}$ |
| $b^3(d - h) + lt^3 - \frac{g}{4}(b^4 - t^4)\Big]$ | $\frac{2I}{b}$ | $r = \sqrt{\frac{I}{A}}$ |
| $d^3 - \frac{1}{8g}(h^4 - l^4)\Big]$ | $\frac{2I}{d}$ | $r = \sqrt{\frac{I}{A}}$ |
| $b^3 + lt^3 + \frac{g}{2}(b^4 - t^4)\Big] - Ax^2$ | $\frac{I}{b - x}$ | $r = \sqrt{\frac{I}{A}}$ |

## PROPERTIES OF VARIOUS SECTIONS.

| Sections. | Area of Section. A | Distance from Neutral Axis to Extremities of Section. x and $x_1$ |
|---|---|---|
|  | $bd - h(b - t)$ | $x_1 = \frac{d}{2}$ |
|  | $bd - h(b - t)$ | $x_1 = \frac{b}{2}$ |
|  | $bd - h(b - t)$ | $x_1 = \frac{d}{2}$ |
|  | $bd - h(b - t)$ | $x = \frac{2b^2s + ht^2}{2A}$<br>$x_1 = b - x$ |
|  | $td + s(b - t)$ | $x_1 = \frac{d}{2}$ |
|  | $bs + ht$ | $x = \frac{d^2t + s^2(b - t)}{2A}$<br>$x_1 = d - x$ |
|  | $bs + ht + b_1s$ | $x = \frac{td^2 + s^2(b-t) + s(b_1-t)(2d}{2A}$<br>$x_1 = d - x$ |
|  | $bs + \frac{h(t + t_1)}{2}$ | $x = \frac{3bs^2 + 3th(d+s) + h(t_1-t)(h+}{6A}$<br>$x_1 = d - x$ |

## ROPERTIES OF VARIOUS SECTIONS.

| ent of Inertia. I | Section Modulus. $S = \frac{I}{x_1}$ | Radius of Gyration. $r = \sqrt{\frac{I}{A}}$ |
|---|---|---|
| $\frac{- h^3 (b-t)}{12}$ | $\frac{bd^3 - h^3 (b-t)}{6d}$ | $\sqrt{\frac{bd^3 - h^3 (b-t)}{12 [bd - h (b-t)]}}$ |
| $\frac{b^3 + ht^3}{12}$ | $\frac{2sb^3 + ht^3}{6b}$ | $\sqrt{\frac{2sb^3 + ht^3}{12 [bd - h (b-t)]}}$ |
| $\frac{- h^3 (b-t)}{12}$ | $\frac{bd^3 - h^3 (b-t)}{6d}$ | $\sqrt{\frac{bd^3 - h^3 (b-t)}{12 [bd - h (b-t)]}}$ |
| $\frac{- ht^3}{} - Ax^2$ | $\frac{I}{b-x}$ | $\sqrt{\frac{I}{A}}$ |
| $\frac{+ s^3 (b-t)}{12}$ | $\frac{td^3 + s^3 (b-t)}{6d}$ | $\sqrt{\frac{td^3 + s^3 (b-t)}{12 [td + s (b-t)]}}$ |
| $\frac{- (b-t) (x-s)^3}{3}$ | $\frac{I}{d-x}$ | $\sqrt{\frac{tx_1^3 + bx^3 - (b-t) (x-s)^3}{3 (bs + ht)}}$ |
| $\frac{- (b-t)(x-s)^3}{3}$ $\frac{- t) (x_1 - s)^3}{3}$ | $\frac{I}{d-x}$ | $\left[\frac{bx^3 + b_1 x_1^3 - (b-t)(x-s)^3}{3 (bs + ht + b_1 s)} - \frac{(b_1 - t) (x_1 - s)^3}{3(bs+ht+b_1 s)}\right]^{\frac{1}{2}}$ |
| $\frac{t + t_1)}{} - A(x-s)^2$ | $\frac{I}{d-x}$ | $\sqrt{\frac{I}{A}}$ |

# EXPLANATIONS OF THE TABLES OF PROPERTIES OF STANDARD AND SPECIAL I-BEAMS, STANDARD AND SPECIAL CHANNELS, STANDARD AND SPECIAL ANGLES WITH EQUAL AND UNEQUAL LEGS, Z-BARS AND T-BARS.

## PROPERTIES OF I-BEAMS.

PAGES 160 TO 163.

The figures or values in the various columns give the section numbers, dimensions, weights, areas and properties of the sections as noted in the different headings.

The columns which require special explanation are as follows:

### SECTION MODULUS—Column 8.

This is obtained from the moment of inertia in column 7 by dividing it by the distance from the neutral axis to the most remote fibre, which in this case is one-half the depth of the beam.

### COEFFICIENTS OF STRENGTH—Columns 13 and 14.

The coefficients of strength F and F′ have been computed for fibre stresses of 16 000 and 12 500 pounds per square inch respectively, as stated in the headings of the columns, and are the safe loads in pounds uniformly distributed, including its own weight for a beam one foot long. Thus the safe load for any span may be obtained by dividing the proper coefficient by the length of the span in feet.

The coefficients of strength were obtained from the following formulæ:

$$F = \tfrac{2}{3} \times 16\,000 \times S$$

$$F' = \tfrac{2}{3} \times 12\,500 \times S$$

in which S is the section modulus.

COEFFICIENTS OF DEFLECTION—Columns 15 and 16.

The coefficients of Deflection N and N′ for uniform and centre oads, respectively, were obtained from the following formulæ:

$$N = \frac{Wl^3}{76.8EI} \qquad N' = \frac{Pl^3}{48EI}$$

ı which

P and W = 1 000 pounds.

l = 12 inches.

E = 29 000 000.

I = moment of inertia about axis 1-1.

These coefficients are therefore the deflections in inches of a beam ne foot long with a load of 1 000 pounds. The deflection of a beam or any load and span may therefore be obtained by multiplying the roper coefficient by the cube of the span in feet, and by the number f 1 000-pound units in the given load.

## PROPERTIES OF STANDARD AND SPECIAL CHANNELS.

PAGES 164 TO 167 INCLUSIVE.

The various columns in the Tables of Properties of Standard Chanıels are similar to those in the Tables of Properties of I-Beams, as explained above, with the addition of column 11, which gives the Section Modulus about an axis through the center of gravity parallel to the web, ınd column 18, which gives the distance of the center of gravity from :he outside of the web. In this case the Section Modulus $S' = \frac{I'}{b - x}$ :he notation being as given at the heads of the columns.

## PROPERTIES OF SPECIAL TROUGH CHANNELS.

PAGES 166 AND 167.

These are similar to the Tables of Properties of Special Channels, ıut with columns 9, 10 and 11 omitted, for the reason that these shapes ıre ordinarily used with the web in a horizontal position. As these :hannels are only rolled to the weights specified, column 16, relating o increase of thickness of web for each pound increase in weight, is ılso omitted.

## PROPERTIES OF T-BARS.

A Table of Properties of Cambria T-Bars is also given on pages 182 and 183.

## PROPERTIES OF ANGLES.

The values in the Tables of Properties of Standard and Special Angles, with Equal Legs, pages 168 to 173, are as stated in the headings and those in the Tables of Properties of Standard and Special Angles with Unequal Legs, on pages 174 to 181, are similar, but with the addition of values for $I''$, $S''$ and $r''$ about the inclined axis 3–3, the position of which, in order to give the minimum values, was determined by the formula on page 144 for the value of the tangent of $2\alpha$. After determining the position of the inclined axis, the properties corresponding thereto were obtained by the formulæ on page 144.

## PROPERTIES OF Z-BARS.

The Tables of Properties of Z-Bars, on pages 184 and 185, are similar to those for Beams and Channels with the addition of values in column 13 for determining the position of the inclined axis 3–3 to give the minimum values of the radius of gyration, as shown in column 14, these values being obtained in a manner similar to that used in calculating like quantities for the Tables of Properties of Angles with Unequal Legs, as explained above.

## MOMENTS OF INERTIA OF RECTANGLES.

A Table of Moments of Inertia of Rectangles is added on pages 186 and 187 for convenience in calculating the Moments of Inertia, Section Moduli, and Radii of Gyration for compound shapes in which plates are used.

## GENERAL FORMULÆ FOR PROPERTIES AND FLEXURE.

Formulæ for obtaining the Properties of Standard Sections are given on pages 144 and 145, and for various usual sections on pages 146 to 153 inclusive.

General formulæ for Flexure of Beams, Bending Moments, and *Deflections* for various cases of loading are given on pages 138 to 143 *sive.*

## EXAMPLES OF APPLICATION OF THE TABLES OF PROPERTIES.

### Example I.

What is the proper size of I-Beam to carry a load of 35 000 pounds concentrated at the center of a span of 25 feet, the fibre stress not to exceed 16 000 pounds per square inch?

In the Tables of Properties of Standard I-Beams, the column headed F gives the coefficient of strength for a uniform load corresponding to a fibre stress of 16 000 pounds per square inch.

The coefficient of strength for a concentrated load at the center is twice that for the same load uniformly distributed, hence the coefficient necessary to meet the conditions is $35\,000 \times 25 \times 2 = 1\,750\,000$. From the Table of Properties of Standard I-Beams, page 163, column 13, the coefficient F for a 24-inch 80-pound beam is found to be 1 855 310. The weight of the beam itself is $80 \times 25 = 2000$ pounds, which corresponds to a coefficient of $2000 \times 25 = 50\,000$, which deducted from 1 855 310 gives a net coefficient of 1 800 310. A 24-inch beam weighing 80 pounds per foot is therefore the proper size.

### Example II.

What is the deflection of the beam in the preceding example under the given load?

In the Table of Properties of Standard I-Beams, pages 160 to 163 inclusive, the coefficient of deflection for beams with center loads is given in column 15. To obtain the required deflection it is only necessary to multiply the coefficient by the cube of the span and the number of 1 000 pound units contained in the load.

Thus for the given example the deflection in inches =

$$.0000006 \times 25^3 \times \frac{35\,000}{1\,000} = .328 \text{ inch.}$$

### Example III.

What is the safe load uniformly distributed that can be placed on an 8-inch standard channel weighing 11.25 pounds per foot, with a clear span of 15 feet for a maximum fibre stress of 12 500 pounds per square inch, the web to be placed vertically?

From the Table of Properties of Standard Channels, page 165, column F′, the coefficient of strength for the given channel under the conditions named is found to be 67 300. Hence the total load may be $67\,300 \div 15 = 4487$ pounds, and as the channel itself weighs 169 pounds, the net superimposed load which it can safely carry under the given conditions is 4318 pounds.

### Example IV.

What is the fibre stress in a 5″ x 3″ angle weighing 8.2 pounds per foot is loaded at the center with a weight of 1500 pounds used as a beam with a span of 6 feet, the 5-inch leg to be placed vertically?

The bending moment at the center will be

$$\frac{W_1 l}{4} + \frac{W_2 l}{8} = \frac{1\,500 \times 72}{4} + \frac{8.2 \times 6 \times 72}{8} = 27\,443 \text{ inch pounds.}$$

Referring to the Table of Properties of Standard Angles, Unequal Legs, on page 177, the Section Modulus for this angle, corresponding to the axis 2—2, is found to be 1.89.

The maximum fibre stress is obtained by dividing the bending moment by the section modulus, thus: $\frac{27\,443}{1.89} = 14\,520$, which is the maximum fibre stress in pounds per square inch at the point most remote from the neutral axis, which in this case is the extremity of the longer leg of the angle.

The second term in the above expression for the bending moment is that due to the weight of the angle itself and is inconsiderable, so that in practice it might be neglected for short spans, but should be taken *into consideration* for the longer ones.

## 'ROPERTIES OF COMPOUND SHAPES.

ıoments of inertia, section moduli and radii of gyration of d shapes used as beams or columns, composed of plates and :hannels, beams, Z-bars, T-bars, or any combination of these, ›btained with the aid of the Tables of Properties as follows:

:st step is to find the center of gravity of the proposed section, the case of symmetrical sections is at the center of the figure. ısymmetrical sections the position of the center of gravity may nined by multiplying the areas of the component parts by the of their centers of gravity from any convenient line, taken as ınd dividing this product by the sum of the areas, which will distance of the centre of gravity of the compound section from ned axis.

›sition of the center of gravity for all sizes of angles, channels, ırs is given in the Tables of Properties for these shapes, and is : various geometrical sections on pages 146 to 153 inclusive, in ›n with their other properties.

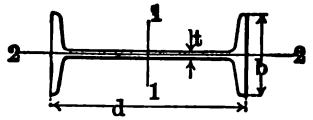
letermining the position of the center of gravity of a compound explained above, the moment of inertia about an axis through · of gravity may be found by taking the sums of the moments of ' each component part about an axis through its own center of ıarallel to the axis of the compound section, and the sums of of the area of each component part by the square of the dis- its center of gravity from the axis of the compound section.

g thus obtained the moment of inertia of the compound section, ion modulus may be obtained by dividing this moment of ›y the distance from the neutral axis to the most remote ex- ›f the section.

ıuare of the radius of gyration for the compound section may ıed by dividing the moment of inertia by the total area.

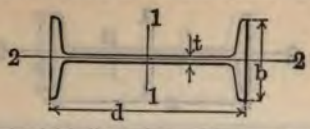
.oment of inertia of a compound section about any axis other t through its center of gravity may be found in a manner › that above described.

## PROPERTIES OF STANDARD I-BEAMS.



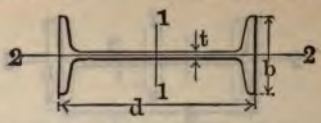

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Section Number. | Depth of Beam. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Moment of Inertia Axis 1-1. | Section Modulus Axis 1-1. | Radius of Gyration Axis 1-1. | Moment of Inertia Axis 2-2. | Radius of Gyration Axis 2-2. |
| | d | | A | t | b | I | S | r | I′ | r′ |
| | Inches. | Pounds. | Sq. Inches | Inches. | Inches. | Inches.$^4$ | Inches.$^3$ | Inches. | Inches.$^4$ | Inches |
| B 5 | 3 | 5.50 | 1.63 | .17 | 2.33 | 2.5 | 1.7 | 1.23 | .46 | .53 |
| " | " | 6.50 | 1.91 | .26 | 2.42 | 2.7 | 1.8 | 1.19 | .53 | .52 |
| " | " | 7.50 | 2.21 | .36 | 2.52 | 2.9 | 1.9 | 1.15 | .60 | .52 |
| B 9 | 4 | 7.50 | 2.21 | .19 | 2.66 | 6.0 | 3.0 | 1.64 | .77 | .59 |
| " | " | 8.50 | 2.50 | .26 | 2.73 | 6.4 | 3.2 | 1.59 | .85 | .58 |
| " | " | 9.50 | 2.79 | .34 | 2.81 | 6.7 | 3.4 | 1.54 | .93 | .58 |
| " | " | 10.50 | 3.09 | .41 | 2.88 | 7.1 | 3.6 | 1.52 | 1.01 | .57 |
| B13 | 5 | 9.75 | 2.87 | .21 | 3.00 | 12.1 | 4.8 | 2.05 | 1.23 | .65 |
| " | " | 12.25 | 3.60 | .36 | 3.15 | 13.6 | 5.4 | 1.94 | 1.45 | .63 |
| " | " | 14.75 | 4.34 | .50 | 3.29 | 15.1 | 6.1 | 1.87 | 1.70 | .63 |
| B17 | 6 | 12.25 | 3.61 | .23 | 3.33 | 21.8 | 7.3 | 2.46 | 1.85 | .72 |
| " | " | 14.75 | 4.34 | .35 | 3.45 | 24.0 | 8.0 | 2.35 | 2.09 | .69 |
| " | " | 17.25 | 5.07 | .47 | 3.57 | 26.2 | 8.7 | 2.27 | 2.36 | .68 |
| B21 | 7 | 15.00 | 4.42 | .25 | 3.66 | 36.2 | 10.4 | 2.86 | 2.67 | .78 |
| " | " | 17.50 | 5.15 | .35 | 3.76 | 39.2 | 11.2 | 2.76 | 2.94 | .76 |
| " | " | 20.00 | 5.88 | .46 | 3.87 | 42.2 | 12.1 | 2.68 | 3.24 | .74 |
| B25 | 8 | 18.00 | 5.33 | .27 | 4.00 | 56.9 | 14.2 | 3.27 | 3.78 | .84 |
| " | " | 20.25 | 5.96 | .35 | 4.08 | 60.2 | 15.0 | 3.18 | 4.04 | .82 |
| " | " | 22.75 | 6.69 | .44 | 4.17 | 64.1 | 16.0 | 3.10 | 4.36 | .81 |
| " | " | 25.25 | 7.43 | .53 | 4.26 | 68.0 | 17.0 | 3.03 | 4.71 | .80 |
| B29 | 9 | 21.00 | 6.31 | .29 | 4.33 | 84.9 | 18.9 | 3.67 | 5.16 | .90 |
| " | " | 25.00 | 7.35 | .41 | 4.45 | 91.9 | 20.4 | 3.54 | 5.65 | .88 |
| " | " | 30.00 | 8.82 | .57 | 4.61 | 101.9 | 22.6 | 3.40 | 6.42 | .85 |
| " | " | 35.00 | 10.29 | .73 | 4.77 | 111.8 | 24.8 | 3.30 | 7.31 | .84 |
| B33 | 10 | 25.00 | 7.37 | .31 | 4.66 | 122.1 | 24.4 | 4.07 | 6.89 | .97 |
| " | " | 30.00 | 8.82 | .45 | 4.80 | 134.2 | 26.8 | 3.90 | 7.65 | .93 |
| " | " | 35.00 | 10.29 | .60 | 4.95 | 146.4 | 29.3 | 3.77 | 8.52 | .91 |
| " | " | 40.00 | 11.76 | .75 | 5.10 | 158.7 | 31.7 | 3.67 | 9.50 | .90 |
| B41 | 12 | 31.50 | 9.26 | .35 | 5.00 | 215.8 | 36.0 | 4.83 | 9.50 | 1.01 |
| " | " | 35.00 | 10.29 | .44 | 5.09 | 228.3 | 38.0 | 4.71 | 10.07 | .99 |
| " | " | 40.00 | 11.76 | .56 | 5.21 | 245.9 | 41.0 | 4.57 | 10.95 | .96 |
| B53 | 15 | 42.00 | 12.48 | .41 | 5.50 | 441.8 | 58.9 | 5.95 | 14.62 | 1.08 |
| " | " | 45.00 | 13.24 | .46 | 5.55 | 455.8 | 60.8 | 5.87 | 15.09 | 1.07 |
| " | " | 50.00 | 14.71 | .56 | 5.65 | 483.4 | 64.5 | 5.73 | 16.04 | 1.04 |
| " | " | 55.00 | 16.18 | .66 | 5.75 | 511.0 | 68.1 | 5.62 | 17.06 | 1.03 |
| " | " | 60.00 | 17.65 | .75 | 5.84 | 538.6 | 71.8 | 5.52 | 18.17 | 1.01 |

## PROPERTIES OF STANDARD I-BEAMS.




| 12 | 13 | 14 | 15 | 16 | 1 |
|---|---|---|---|---|---|
| ase of kness eb for Pound rease Veight | Coefficient of Strength. | | Coefficient of Deflection. | | |
| | For Fibre Stress of 16 000 Pounds per Square Inch for Buildings. | For Fibre Stress of 12 500 Pounds per Square Inch for Bridges. | Uniform Load. | Center Load. | Section Number. |
| f | F | F′ | N | N′ | |
| 98 | 17650 | 13790 | .00031253 | .00050006 | B 5 |
| | 19140 | 14950 | .00028827 | .00046124 | " |
| | 20710 | 16180 | .00026644 | .00042630 | " |
| 74 | 31810 | 24850 | .00013009 | .00020815 | B 9 |
| | 33890 | 26480 | .00012209 | .00019535 | " |
| | 35980 | 28110 | .00011500 | .00018400 | " |
| | 38070 | 29750 | .00010868 | .00017389 | " |
| 59 | 51590 | 40300 | .00006417 | .00010267 | B13 |
| | 58100 | 45390 | .00005698 | .00009117 | " |
| | 64630 | 50490 | .00005122 | .00008195 | " |
| 49 | 77460 | 60520 | .00003561 | .00005698 | B17 |
| | 85270 | 66610 | .00003235 | .00005177 | " |
| | 93110 | 72740 | .00002963 | .00004741 | " |
| 42 | 110410 | 86260 | .00002142 | .00003427 | B21 |
| | 119400 | 93290 | .00001980 | .00003168 | " |
| | 128560 | 100430 | .00001839 | .00002943 | " |
| 37 | 151660 | 118490 | .00001364 | .00002183 | B25 |
| | 160510 | 125400 | .00001289 | .00002062 | " |
| | 170970 | 133570 | .00001210 | .00001936 | " |
| | 181430 | 141740 | .00001140 | .00001825 | " |
| 33 | 201300 | 157260 | .00000914 | .00001462 | B29 |
| | 217930 | 170260 | .00000844 | .00001350 | " |
| | 241460 | 188640 | .00000762 | .00001219 | " |
| | 264990 | 207020 | .00000694 | .00001110 | " |
| 29 | 260470 | 203500 | .00000635 | .00001017 | B33 |
| | 286250 | 223630 | .00000578 | .00000925 | " |
| | 312390 | 244050 | .00000530 | .00000848 | " |
| | 338530 | 264480 | .00000489 | .00000782 | " |
| 25 | 383670 | 299740 | .00000360 | .00000575 | B41 |
| | 405800 | 317030 | .00000340 | .00000544 | " |
| | 437170 | 341540 | .00000316 | .00000505 | " |
| 20 | 628270 | 490840 | .00000176 | .00000281 | B53 |
| | 648310 | 506490 | .00000170 | .00000272 | " |
| | 687530 | 537130 | .00000161 | .00000257 | " |
| | 726740 | 567770 | .00000152 | .00000243 | " |
| | *765960* | *598410* | .00000144 | .00000231 | " |

## PROPERTIES OF STANDARD I-BEAMS.

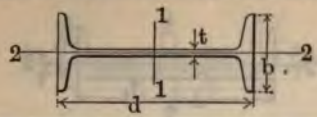



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Section Number. | Depth of Beam. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Moment of Inertia Axis 1-1. | Section Modulus Axis 1-1. | Radius of Gyration Axis 1-1. | Moment of Inertia Axis 2-2. | Radius of Gyration Axis 2-2. |
| | d | | A | t | b | I | S | r | I′ | r′ |
| | Inches. | Pounds. | Sq.Inches | Inches. | Inches. | Inches.⁴ | Inches.³ | Inches. | Inches.⁴ | Inches. |
| B 65 | 18 | 55.0 | 15.93 | .46 | 6.00 | 795.6 | 88.4 | 7.07 | 21.19 | 1.15 |
| " | " | 60.0 | 17.65 | .56 | 6.10 | 841.8 | 93.5 | 6.91 | 22.38 | 1.13 |
| " | " | 65.0 | 19.12 | .64 | 6.18 | 881.5 | 97.9 | 6.79 | 23.47 | 1.11 |
| " | " | 70.0 | 20.59 | .72 | 6.26 | 921.2 | 102.4 | 6.69 | 24.62 | 1.09 |
| B 73 | 20 | 65.0 | 19.08 | .50 | 6.25 | 1169.5 | 117.0 | 7.83 | 27.86 | 1.21 |
| " | " | 70.0 | 20.59 | .58 | 6.33 | 1219.8 | 122.0 | 7.70 | 29.04 | 1.19 |
| " | " | 75.0 | 22.06 | .65 | 6.40 | 1268.8 | 126.9 | 7.58 | 30.25 | 1.17 |
| B 89 | 24 | 80.0 | 23.32 | .50 | 7.00 | 2087.2 | 173.9 | 9.46 | 42.86 | 1.36 |
| " | " | 85.0 | 25.00 | .57 | 7.07 | 2167.8 | 180.7 | 9.31 | 44.35 | 1.33 |
| " | " | 90.0 | 26.47 | .63 | 7.13 | 2238.4 | 186.5 | 9.20 | 45.70 | 1.31 |
| " | " | 95.0 | 27.94 | .69 | 7.19 | 2309.0 | 192.4 | 9.09 | 47.10 | 1.30 |
| " | " | 100.0 | 29.41 | .75 | 7.25 | 2379.6 | 198.3 | 8.99 | 48.55 | 1.28 |

## PROPERTIES OF SPECIAL I-BEAMS.

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| B105 | 12 | 40.0 | 11.84 | .46 | 5.25 | 268.9 | 44.8 | 4.77 | 13.81 | 1.08 |
| " | " | 45.0 | 13.24 | .58 | 5.37 | 285.7 | 47.6 | 4.65 | 14.89 | 1.06 |
| " | " | 50.0 | 14.71 | .70 | 5.49 | 303.4 | 50.6 | 4.54 | 16.12 | 1.05 |
| " | " | 55.0 | 16.18 | .82 | 5.61 | 321.0 | 53.5 | 4.45 | 17.46 | 1.04 |
| B109 | 15 | 60.0 | 17.67 | .59 | 6.00 | 609.0 | 81.2 | 5.87 | 25.96 | 1.21 |
| " | " | 65.0 | 19.12 | .69 | 6.10 | 636.1 | 84.8 | 5.77 | 27.42 | 1.20 |
| " | " | 70.0 | 20.59 | .78 | 6.19 | 663.7 | 88.5 | 5.68 | 29.00 | 1.19 |
| " | " | 75.0 | 22.06 | .88 | 6.29 | 691.2 | 92.2 | 5.60 | 30.68 | 1.18 |
| " | " | 80.0 | 23.53 | .98 | 6.39 | 718.8 | 95.8 | 5.53 | 32.46 | 1.17 |
| B113 | 15 | 80.0 | 23.57 | .80 | 6.40 | 789.1 | 105.2 | 5.79 | 41.31 | 1.32 |
| " | " | 85.0 | 25.00 | .90 | 6.50 | 815.9 | 108.8 | 5.71 | 43.46 | 1.32 |
| " | " | 90.0 | 26.47 | .99 | 6.59 | 843.4 | 112.5 | 5.64 | 45.79 | 1.32 |
| " | " | 95.0 | 27.94 | 1.09 | 6.69 | 871.0 | 116.1 | 5.58 | 48.25 | 1.31 |
| " | " | 100.0 | 29.41 | 1.19 | 6.79 | 898.6 | 119.8 | 5.53 | 50.84 | 1.31 |
| B121 | 20 | 80.0 | 23.73 | .60 | 7.00 | 1466.3 | 146.6 | 7.86 | 45.81 | 1.39 |
| " | " | 85.0 | 25.00 | .66 | 7.06 | 1508.5 | 150.9 | 7.77 | 47.25 | 1.37 |
| " | " | 90.0 | 26.47 | .74 | 7.14 | 1557.5 | 155.8 | 7.67 | 48.98 | 1.36 |
| " | " | 95.0 | 27.94 | .81 | 7.21 | 1606.6 | 160.7 | 7.58 | 50.78 | 1.35 |
| " | " | 100.0 | 29.41 | .88 | 7.28 | 1655.6 | 165.6 | 7.50 | 52.65 | 1.34 |

## PROPERTIES OF STANDARD I-BEAMS.

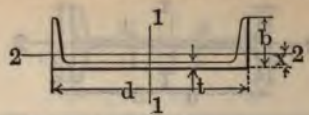



| 12 | 13 | 14 | 15 | 16 | 1 |
|---|---|---|---|---|---|
| ncrease of Thickness f Web for ach Pound Increase n Weight. | Coefficient of Strength. For Fibre Stress of 16 000 Pounds per Square Inch for Buildings. | Coefficient of Strength. For Fibre Stress of 12 500 Pounds per Square Inch for Bridges. | Coefficient of Deflection. Uniform Load. | Coefficient of Deflection. Center Load. | Section Number. |
| f | F | F′ | N | N′ | |
| .016 | 942880 | 736620 | .00000098 | .00000156 | B 65 |
| | 997680 | 779440 | .00000092 | .00000148 | " |
| | 1044740 | 816200 | .00000088 | .00000141 | " |
| | 1091800 | 852970 | .00000084 | .00000135 | " |
| .015 | 1247490 | 974600 | .00000066 | .00000106 | B 73 |
| | 1301110 | 1016490 | .00000064 | .00000102 | " |
| | 1353400 | 1057340 | .00000061 | .00000098 | " |
| .0123 | 1855310 | 1449460 | .00000037 | .00000060 | B 89 |
| | 1926950 | 1505430 | .00000036 | .00000057 | " |
| | 1989700 | 1554450 | .00000035 | .00000056 | " |
| | 2052440 | 1603470 | .00000034 | .00000054 | " |
| | 2115190 | 1652490 | .00000033 | .00000052 | " |

## PROPERTIES OF SPECIAL I-BEAMS.

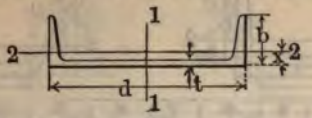
| | | | | | |
|---|---|---|---|---|---|
| .025 | 478130 | 373540 | .00000288 | .00000462 | B105 |
| | 507930 | 396820 | .00000272 | .00000485 | " |
| | 539300 | 421320 | .00000256 | .00000409 | " |
| | 570670 | 445830 | .00000242 | .00000387 | " |
| .020 | 866130 | 676670 | .00000127 | .00000204 | B109 |
| | 904660 | 706770 | .00000122 | .00000195 | " |
| | 943870 | 737400 | .00000117 | .00000187 | " |
| | 983090 | 768040 | .00000112 | .00000180 | " |
| | 1022300 | 798670 | .00000108 | .00000173 | " |
| .020 | 1122290 | 876790 | .00000098 | .00000157 | B113 |
| | 1160340 | 906520 | .00000095 | .00000152 | " |
| | 1199550 | 937150 | .00000092 | .00000147 | " |
| | 1238770 | 967790 | .00000089 | .00000143 | " |
| | 1277980 | 998420 | .00000086 | .00000138 | " |
| .015 | 1564060 | 1221920 | .00000053 | .00000085 | B121 |
| | 1609100 | 1257110 | .00000051 | .00000082 | " |
| | 1661390 | 1297960 | .00000050 | .00000080 | " |
| | 1713670 | 1338810 | .00000048 | .00000077 | " |
| | *1765960* | *1379660* | .00000047 | .00000075 | " |

## PROPERTIES OF STANDARD CHANNELS.



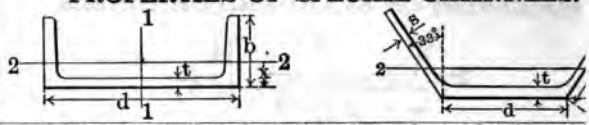

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Section Number | Depth of Channel. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Moment of Inertia Axis 1-1. | Section Modulus Axis 1-1. | Radius of Gyration Axis 1-1. | Moment of Inertia Axis 2-2. | Section Modulus Axis 2-2. | Radius of Gyration Axis 2-2. |
| | d | | A | t | b | I | S | r | I′ | S′ | r′ |
| | Inches. | Pounds. | Sq. Ins. | Inches. | Inches. | Inches.⁴ | Inch'es³ | Inches. | Inches.⁴ | Inches³ | Inches. |
| C 5 | 3 | 4.00 | 1.19 | .17 | 1.41 | 1.6 | 1.1 | 1.17 | .20 | .21 | .41 |
| " | " | 5.00 | 1.47 | .26 | 1.50 | 1.8 | 1.2 | 1.12 | .25 | .24 | .41 |
| " | " | 6.00 | 1.76 | .36 | 1.60 | 2.1 | 1.4 | 1.08 | .31 | .27 | .42 |
| C 9 | 4 | 5.25 | 1.55 | .18 | 1.58 | 3.8 | 1.9 | 1.56 | .32 | .29 | .45 |
| " | " | 6.25 | 1.84 | .25 | 1.65 | 4.2 | 2.1 | 1.51 | .38 | .32 | .45 |
| " | " | 7.25 | 2.13 | .33 | 1.73 | 4.6 | 2.3 | 1.46 | .44 | .35 | .46 |
| C13 | 5 | 6.50 | 1.95 | .19 | 1.75 | 7.4 | 3.0 | 1.95 | .48 | .38 | .50 |
| " | " | 9.00 | 2.65 | .33 | 1.89 | 8.9 | 3.5 | 1.83 | .64 | .45 | .49 |
| " | " | 11.50 | 3.38 | .48 | 2.04 | 10.4 | 4.2 | 1.75 | .82 | .54 | .49 |
| C17 | 6 | 8.00 | 2.38 | .20 | 1.92 | 13.0 | 4.3 | 2.34 | .70 | .50 | .54 |
| " | " | 10.50 | 3.09 | .32 | 2.04 | 15.1 | 5.0 | 2.21 | .88 | .57 | .53 |
| " | " | 13.00 | 3.82 | .44 | 2.16 | 17.3 | 5.8 | 2.13 | 1.07 | .65 | .53 |
| " | " | 15.50 | 4.56 | .56 | 2.28 | 19.5 | 6.5 | 2.07 | 1.28 | .74 | .53 |
| C21 | 7 | 9.75 | 2.85 | .21 | 2.09 | 21.1 | 6.0 | 2.72 | .98 | .63 | .59 |
| " | " | 12.25 | 3.60 | .32 | 2.20 | 24.2 | 6.9 | 2.59 | 1.19 | .71 | .57 |
| " | " | 14.75 | 4.34 | .42 | 2.30 | 27.2 | 7.8 | 2.50 | 1.40 | .79 | .57 |
| " | " | 17.25 | 5.07 | .53 | 2.41 | 30.2 | 8.6 | 2.44 | 1.62 | .87 | .56 |
| " | " | 19.75 | 5.81 | .63 | 2.51 | 33.2 | 9.5 | 2.39 | 1.85 | .96 | .56 |
| C25 | 8 | 11.25 | 3.35 | .22 | 2.26 | 32.3 | 8.1 | 3.10 | 1.33 | .79 | .63 |
| " | " | 13.75 | 4.04 | .31 | 2.35 | 36.0 | 9.0 | 2.98 | 1.55 | .87 | .62 |
| " | " | 16.25 | 4.78 | .40 | 2.44 | 39.9 | 10.0 | 2.89 | 1.78 | .95 | .61 |
| " | " | 18.75 | 5.51 | .49 | 2.53 | 43.8 | 11.0 | 2.82 | 2.01 | 1.02 | .60 |
| " | " | 21.25 | 6.25 | .58 | 2.62 | 47.8 | 11.9 | 2.76 | 2.25 | 1.11 | .60 |
| C29 | 9 | 13.25 | 3.89 | .23 | 2.43 | 47.3 | 10.5 | 3.49 | 1.77 | .97 | .67 |
| " | " | 15.00 | 4.41 | .29 | 2.49 | 50.9 | 11.3 | 3.40 | 1.95 | 1.03 | .66 |
| " | " | 20.00 | 5.88 | .45 | 2.65 | 60.8 | 13.5 | 3.21 | 2.45 | 1.19 | .65 |
| " | " | 25.00 | 7.35 | .61 | 2.81 | 70.7 | 15.7 | 3.10 | 2.98 | 1.36 | .64 |
| C33 | 10 | 15.00 | 4.46 | .24 | 2.60 | 66.9 | 13.4 | 3.87 | 2.30 | 1.17 | .72 |
| " | " | 20.00 | 5.88 | .38 | 2.74 | 78.7 | 15.7 | 3.66 | 2.85 | 1.34 | .70 |
| " | " | 25.00 | 7.35 | .53 | 2.89 | 91.0 | 18.2 | 3.52 | 3.40 | 1.50 | .68 |
| " | " | 30.00 | 8.82 | .68 | 3.04 | 103.2 | 20.6 | 3.42 | 3.99 | 1.67 | .67 |
| " | " | 35.00 | 10.29 | .82 | 3.18 | 115.5 | 23.1 | 3.35 | 4.66 | 1.87 | .67 |
| C41 | 12 | 20.50 | 6.03 | .28 | 2.94 | 128.1 | 21.4 | 4.61 | 3.91 | 1.75 | .81 |
| " | " | 25.00 | 7.35 | .39 | 3.05 | 144.0 | 24.0 | 4.43 | 4.53 | 1.91 | .78 |
| " | " | 30.00 | 8.82 | .51 | 3.17 | 161.6 | 26.9 | 4.28 | 5.21 | 2.09 | .77 |
| " | " | 35.00 | 10.29 | .64 | 3.30 | 179.3 | 29.9 | 4.17 | 5.90 | 2.27 | .76 |
| " | " | 40.00 | 11.76 | .76 | 3.42 | 196.9 | 32.8 | 4.09 | 6.63 | 2.46 | .75 |
| C53 | 15 | 33.00 | 9.90 | .40 | 3.40 | 312.6 | 41.7 | 5.62 | 8.23 | 3.16 | .91 |
| " | " | 35.00 | 10.29 | .43 | 3.43 | 319.9 | 42.7 | 5.57 | 8.48 | 3.22 | .91 |
| " | " | 40.00 | 11.76 | .52 | 3.52 | 347.5 | 46.3 | 5.44 | 9.39 | 3.43 | .89 |
| " | " | 45.00 | 13.24 | .62 | 3.62 | 375.1 | 50.0 | 5.32 | 10.29 | 3.63 | .88 |
| " | " | 50.00 | 14.71 | .72 | 3.72 | 402.7 | 53.7 | 5.23 | 11.22 | 3.85 | .87 |
| " | " | 55.00 | 16.18 | .82 | 3.82 | 430.2 | 57.4 | 5.16 | 12.19 | 4.07 | .87 |

# PROPERTIES OF STANDARD CHANNELS.



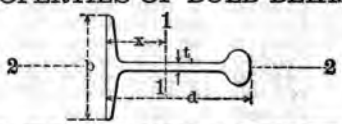

| 13 | 14 | 15 | 16 | 17 | 18 | 1 |
|---|---|---|---|---|---|---|
| tance enter ravity rom ide of eb. | Increase of Thickness of Web for each Pound Increase in Weight. | Coef. of Strength. Fibre Stress 16 000 Pounds per Sq. Inch for Buildings. | Coef. of Strength. Fibre Stress 12 500 Pounds per Sq. Inch. for Bridges. | Coef. of Deflection. Uniform Load. | Coef. of Deflection. Center Load. | Section Number. |
| x | f | F | F′ | N | N′ | |
| ches. | Inches. | | | | | |
| 4 | .098 | 11630 | 9090 | .0004743 | .0007589 | C 5 |
| 4 | | 13140 | 10270 | .0004199 | .0006718 | " |
| 6 | | 14710 | 11490 | .0003751 | .0006001 | " |
| 8 | .074 | 20230 | 15800 | .0002046 | .0003273 | C 9 |
| 6 | | 22270 | 17400 | .0001858 | .0002973 | " |
| 6 | | 24360 | 19030 | .0001698 | .0002717 | " |
| 9 | .059 | 31640 | 24720 | .0001046 | .0001674 | C13 |
| 8 | | 37860 | 29570 | .0000875 | .0001399 | " |
| 1 | | 44390 | 34680 | .0000746 | .0001193 | " |
| 2 | .049 | 46210 | 36100 | .0000597 | .0000855 | C17 |
| 0 | | 53750 | 42000 | .0000513 | .0000821 | " |
| 2 | | 61600 | 48120 | .0000448 | .0000717 | " |
| 5 | | 69440 | 54250 | .0000397 | .0000636 | " |
| 5 | .042 | 64270 | 50210 | .0000368 | .0000588 | C21 |
| 3 | | 73650 | 57540 | .0000321 | .0000714 | " |
| 3 | | 82740 | 64690 | .0000286 | .0000457 | " |
| 5 | | 91950 | 71840 | .0000257 | .0000411 | " |
| 8 | | 101100 | 78990 | .0000234 | .0000374 | " |
| 8 | .037 | 86140 | 67300 | .0000240 | .0000384 | C25 |
| 6 | | 95990 | 75000 | .0000216 | .0000345 | " |
| 6 | | 106450 | 83170 | .0000194 | .0000311 | " |
| 7 | | 116910 | 91340 | .0000177 | .0000283 | " |
| 9 | | 127370 | 99510 | .0000162 | .0000260 | " |
| 1 | .033 | 112170 | 87630 | .0000164 | .0000262 | C29 |
| 9 | | 120540 | 94170 | .0000153 | .0000244 | " |
| 8 | | 144070 | 112550 | .0000128 | .0000204 | " |
| 2 | | 167590 | 130930 | .0000110 | .0000176 | " |
| 4 | .029 | 142680 | 111470 | .0000116 | .0000186 | C33 |
| 1 | | 167940 | 131210 | .0000099 | .0000158 | " |
| 2 | | 194090 | 151630 | .0000085 | .0000136 | " |
| 5 | | 220230 | 172060 | .0000075 | .0000120 | " |
| 9 | | 246380 | 192480 | .0000067 | .0000107 | " |
| 0 | .025 | 227750 | 177930 | .0000061 | .0000097 | C41 |
| 8 | | 256000 | 200000 | .0000054 | .0000086 | " |
| 8 | | 287370 | 224510 | .0000048 | .0000077 | " |
| 9 | | 318750 | 249020 | .0000043 | .0000069 | " |
| 2 | | 350120 | 273530 | .0000039 | .0000063 | " |
| 9 | .020 | 444520 | 347280 | .0000025 | .0000040 | C53 |
| 9 | | 455030 | 355500 | .0000024 | .0000039 | " |
| 8 | | 494250 | 386130 | .0000022 | .0000036 | " |
| 9 | | 533470 | 416770 | .0000021 | .0000033 | " |
| 0 | | 572680 | 447410 | .0000019 | .0000031 | " |
| 2 | | *611900* | 478050 | .0000018 | .0000029 | " |

## PROPERTIES OF SPECIAL CHANNELS.



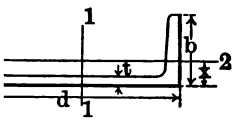

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Section Number. | Depth of Chan'l. | W'ght per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Thickness of Flange | Slope of Flange. | Moment of Inertia Axis 1-1. | Section Modulus Axis 1-1. | Radius of Gyration Axis 1-1. | Moment of Inertia Axis 2 |
| | d | | A | t | b | s | g | I | S | r | I' |
| | Ins. | Lbs. | Sq. Ins. | Inches | Inches. | Inches | | Inches.[4] | Ins.[3] | Inches | Inches |
| C73 | 4 | 6.3 | 1.85 | .375 | .875 | .34 | .06 | 3.2 | 1.6 | 1.31 | .( |
| C87 | 6 | 14.0 | 4.11 | .28 | 2.96 | .41 | .04 | 23.7 | 7.9 | 2.40 | 3.5 |
| " | " | 17.0 | 5.00 | .43 | 3.11 | " | " | 26.4 | 8.8 | 2.30 | 4.3 |
| " | " | 20.0 | 5.88 | .58 | 3.26 | " | " | 29.1 | 9.7 | 2.22 | 5.1 |
| C91 | 12 | 21.4 | 6.30 | .31 | 2.64 | .34 | .17 | 128.2 | 21.4 | 4.51 | 3.3 |
| " | " | 23.9 | 7.03 | .37 | 2.70 | " | " | 137.0 | 22.8 | 4.41 | 3.5 |
| " | " | 26.4 | 7.77 | .44 | 2.76 | " | " | 145.9 | 24.3 | 4.33 | 3.5 |
| " | " | 28.9 | 8.50 | .50 | 2.82 | " | " | 154.7 | 25.8 | 4.27 | 4.( |
| " | " | 31.4 | 9.24 | .56 | 2.89 | " | " | 163.5 | 27.3 | 4.21 | 4.3 |
| " | " | 33.9 | 9.97 | .62 | 2.95 | " | " | 172.3 | 28.7 | 4.16 | 4.( |
| C95 | 13 | 32.0 | 9.53 | .38 | 4.00 | .34 | .15 | 290.0 | 44.6 | 5.52 | 11.7 |
| " | " | 35.0 | 10.29 | .43 | 4.06 | " | " | 300.8 | 46.3 | 5.41 | 12.1 |
| " | " | 40.0 | 11.76 | .55 | 4.17 | " | " | 321.5 | 49.5 | 5.23 | 14.( |
| " | " | 45.0 | 13.24 | .66 | 4.29 | " | " | 342.2 | 52.6 | 5.08 | 15.4 |
| " | " | 50.0 | 14.71 | .77 | 4.40 | " | " | 362.9 | 55.8 | 4.97 | 16.5 |
| " | " | 55.0 | 16.18 | .89 | 4.51 | " | " | 383.6 | 59.0 | 4.87 | 18.3 |
| C75 | 5 | 15.2 | 4.46 | .50 | 4.29 | .24 | . . . | . . . | . . . | . . . | 4. |
| C79 | " | 23.5 | 6.91 | .75 | 4.50 | .375 | . . . | . . . | . . . | . . . | 7. |
| C83 | " | 19.3 | 5.68 | .50 | 4.50 | .375 | . . . | . . . | . . . | . . . | 6. |

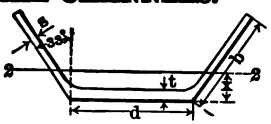
## PROPERTIES OF BULB BEAMS.




| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Section Number. | Depth of Beam. | Weight per Foot. | Area of Section. | Thickness of Web. | Width of Flange. | Moment of Inertia Axis 1-1. | Section Modulus Axis 1-1. |
| | d | | A | t | b | I | S |
| | Inches. | Pounds. | Sq. Ins. | Inches. | Inches. | Inches.[4] | Inches.[3] |
| B171 | $5\frac{7}{32}$ | 11.5 | 3.37 | $\frac{9}{32}$ | $2\frac{7}{8}$ | 11.39 | 3.71 |
| B173 | 6 | 14.0 | 4.11 | $\frac{9}{32}$ | $4\frac{3}{8}$ | 21.52 | 6.12 |
| " | " | 15.3 | 4.48 | $\frac{19}{64}$ | $4\frac{7}{16}$ | 22.73 | 6.55 |
| " | " | 18.4 | 5.42 | $\frac{7}{32}$ | $4\frac{1}{16}$ | 25.72 | 7.59 |

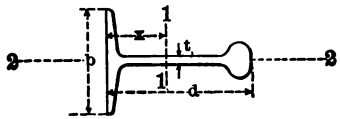
## PROPERTIES OF SPECIAL CHANNELS.




| 15 | 16 | 17 | 18 | 19 | 20 | 1 |
|---|---|---|---|---|---|---|
| stance of nter of ravity from utside f Web. | Increase of Thickness of Web for each Lb. Increase in Weight. | Coef. of Strength. | | Coef. of Deflection. | | |
| | | Fibre Stress 16 000 Pounds per Sq. Inch for Buildings. | Fibre Stress 12 500 Pounds per Sq. Inch for Bridges. | Uniform Load. | Center Load. | Section Number. |
| x | f | F | F′ | N | N′ | |
| inches. | Inches. | | | | | |
| .27 | | 17040 | 13310 | .0002429 | .0003886 | C73 |
| .99 | .049 | 84440 | 65970 | .0000327 | .0000523 | C87 |
| .95 | " | 93950 | 73400 | .0000294 | .0000470 | " |
| .94 | " | 103370 | 80750 | .0000267 | .0000427 | " |
| .63 | .024 | 227950 | 178080 | .0000061 | .0000097 | C91 |
| .62 | " | 243630 | 190340 | .0000057 | .0000091 | " |
| .62 | " | 259320 | 202590 | .0000053 | .0000085 | " |
| .63 | " | 275000 | 214850 | .0000050 | .0000080 | " |
| .64 | " | 290690 | 227100 | .0000048 | .0000076 | " |
| .65 | " | 306380 | 239360 | .0000045 | .0000072 | " |
| 1.03 | .023 | 475960 | 371850 | .0000027 | .0000043 | C95 |
| 1.01 | " | 493620 | 385640 | .0000026 | .0000041 | " |
| .99 | " | 527610 | 412190 | .0000024 | .0000039 | " |
| .98 | " | 561590 | 438740 | .0000023 | .0000036 | " |
| .99 | " | 595580 | 465300 | .0000021 | .0000034 | " |
| 1.01 | " | 629570 | 491850 | .0000020 | .0000032 | " |
| .99 | . . . | 16890 | 13190 | .000179 | .000287 | C75 |
| 1.17 | . . . | 28370 | 22160 | .000104 | .000166 | C79 |
| 1.28 | . . . | 26460 | 20680 | .000116 | .000186 | C83 |

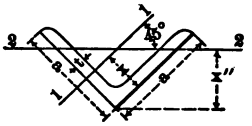
## PROPERTIES OF BULB BEAMS.




| f | 11 | 12 | 13 | 14 | 15 | 1 |
|---|---|---|---|---|---|---|
| m f | Increase of Thickness of Web for each Lb. Increase in Weight. | Coef. of Strength. | | Coef. of Deflection. | | |
| | | Fibre Stress 16 000 Pounds per Sq. Inch for Buildings. | Fibre Stress 12 500 Pounds per Sq. Inch for Bridges. | Uniform Load. | Center Load. | Section Number. |
| — | f | F | F′ | N | N′ | |
| | . . . | 39600 | 30940 | .0000681 | .0001090 | B171 |
| | .049 | 65320 | 51030 | .0000361 | .0000577 | B173 |
| | " | *69960* | 54580 | .0000341 | .0000546 | " |
| | " | *80930* | 63230 | .0000302 | .0000483 | " |

# PROPERTIES OF STANDARD ANGLES.

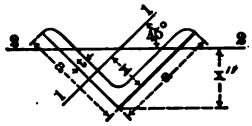
## EQUAL LEGS.




| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Section Number. | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Distance of Center of Gravity from Back of Flange. | Moment of Inertia Axis 1-1. |
| | a x a | t | | A | x | I |
| | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches.$^4$ |
| A 5 | ¾ x ¾ | ⅛ | .58 | .17 | .23 | .009 |
| " | " | 1/16 | .84 | .25 | .25 | .013 |
| A 7 | 1 x 1 | ⅛ | .80 | .23 | .30 | .022 |
| " | " | 3/16 | 1.16 | .34 | .32 | .030 |
| " | " | ¼ | 1.49 | .44 | .34 | .037 |
| A 9 | 1¼ x 1¼ | ⅛ | 1.02 | .30 | .36 | .044 |
| " | " | 3/16 | 1.47 | .43 | .38 | .061 |
| " | " | ¼ | 1.91 | .56 | .40 | .077 |
| " | " | 5/16 | 2.32 | .68 | .42 | .090 |
| A11 | 1½ x 1½ | ⅛ | 1.23 | .36 | .42 | .08 |
| " | " | 3/16 | 1.79 | .53 | .44 | .11 |
| " | " | 7/32 | 2.34 | .69 | .47 | .14 |
| " | " | ¼ | 2.86 | .84 | .49 | .16 |
| " | " | 5/16 | 3.35 | .98 | .51 | .19 |
| " | " | 7/16 | 3.81 | 1.12 | .53 | .21 |
| A13 | 1¾ x 1¾ | 3/16 | 2.11 | .62 | .51 | .18 |
| " | " | 7/32 | 2.76 | .81 | .53 | .23 |
| " | " | ¼ | 3.39 | 1.00 | .55 | .27 |
| " | " | 5/16 | 3.98 | 1.17 | .57 | .31 |
| " | " | 7/16 | 4.56 | 1.34 | .59 | .35 |
| " | " | ½ | 5.10 | 1.50 | .61 | .38 |
| A15 | 2 x 2 | 3/16 | 2.43 | .71 | .57 | .27 |
| " | " | 7/32 | 3.19 | .94 | .59 | .35 |
| " | " | ¼ | 3.92 | 1.15 | .61 | .43 |
| " | " | 5/16 | 4.62 | 1.36 | .64 | .48 |
| " | " | 7/16 | 5.30 | 1.56 | .66 | .54 |
| " | " | ½ | 5.95 | 1.75 | .68 | .59 |
| A17 | 2½ x 2½ | 3/16 | 3.1 | .90 | .69 | .55 |
| " | " | 7/32 | 4.0 | 1.19 | .72 | .70 |
| " | " | ¼ | 5.0 | 1.46 | .74 | .85 |
| " | " | 5/16 | 5.9 | 1.73 | .76 | .98 |
| " | " | 7/16 | 6.8 | 2.00 | .78 | 1.11 |
| " | " | ½ | 7.7 | 2.25 | .81 | 1.23 |
| " | " | 9/16 | 8.5 | 2.50 | .83 | 1.34 |

# PROPERTIES OF STANDARD ANGLES.

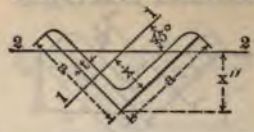
## EQUAL LEGS.




| 9 | 10 | 11 | 12 | 13 | 1 |
|---|---|---|---|---|---|
| Radius of Gyration Axis 1-1. | Distance of Center of Gravity from External Apex. | Least Moment of Inertia. Axis 2-2. | Section Modulus Axis 2-2. | Least Radius of Gyration Axis 2-2. | Section Number. |
| r | x'' | I'' | S'' | r'' | |
| Inches. | Inches. | Inches.$^4$ | Inches.$^3$ | Inches. | |
| .22 | .33 | .004 | .011 | .14 | A 5 |
| .22 | .36 | .005 | .014 | .14 | " |
| .30 | .42 | .009 | .021 | .19 | A 7 |
| .30 | .45 | .013 | .028 | .19 | " |
| .29 | .48 | .016 | .034 | .19 | " |
| .38 | .51 | .018 | .035 | .24 | A 9 |
| .38 | .54 | .025 | .047 | .24 | " |
| .37 | .57 | .033 | .057 | .24 | " |
| .36 | .60 | .040 | .066 | .24 | " |
| .47 | .60 | .031 | .053 | .30 | A11 |
| .46 | .63 | .045 | .072 | .29 | " |
| .45 | .66 | .058 | .088 | .29 | " |
| .44 | .69 | .070 | .101 | .29 | " |
| .44 | .72 | .082 | .114 | .29 | " |
| .43 | .75 | .094 | .126 | .29 | " |
| .54 | .72 | .073 | .10 | .34 | A13 |
| .53 | .75 | .094 | .13 | .34 | " |
| .52 | .78 | .113 | .15 | .34 | " |
| .51 | .81 | .133 | .16 | .34 | " |
| .51 | .84 | .152 | .18 | .34 | " |
| .50 | .87 | .171 | .20 | .34 | " |
| .62 | .80 | .11 | .14 | .39 | A15 |
| .61 | .84 | .14 | .17 | .39 | " |
| .60 | .87 | .17 | .20 | .39 | " |
| .59 | .90 | .20 | .22 | .39 | " |
| .59 | .93 | .23 | .25 | .38 | " |
| .58 | .96 | .26 | .27 | .38 | " |
| .78 | .98 | .22 | .22 | .49 | A17 |
| .77 | 1.01 | .29 | .28 | .49 | " |
| .76 | 1.05 | .35 | .33 | .49 | " |
| .75 | 1.08 | .41 | .38 | .48 | " |
| .75 | 1.11 | .46 | .42 | .48 | " |
| .74 | 1.14 | .52 | .46 | .48 | " |
| .73 | 1.17 | .58 | .49 | .48 | " |

# PROPERTIES OF STANDARD ANGLES.

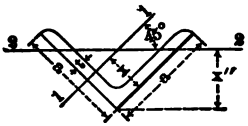
## EQUAL LEGS.




| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Section Number. | Dimensions, a x a | Thickness. t | Weight per Foot. | Area of Section. A | Distance of Center of Gravity from Back of Flange. x | Moment of Inertia Axis 1-1. I | Section Modulus Axis 1-1. S |
| | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches.$^4$ | Inches.$^3$ |
| A19 | 3 x 3 | 1/4 | 4.9 | 1.44 | .84 | 1.24 | .58 |
| " | " | 5/16 | 6.0 | 1.78 | .87 | 1.51 | .71 |
| " | " | 3/8 | 7.2 | 2.11 | .89 | 1.76 | .83 |
| " | " | 7/16 | 8.3 | 2.43 | .91 | 1.99 | .95 |
| " | " | 1/2 | 9.4 | 2.75 | .93 | 2.2[illegible] | 1.07 |
| " | " | 9/16 | 10.4 | 3.06 | .95 | 2.4[illegible]3 | 1.19 |
| " | " | 5/8 | 11.4 | 3.36 | .98 | 2.6[illegible]2 | 1.30 |
| " | " | 11/16 | 12.4 | 3.65 | 1.00 | 2.8[illegible]1 | 1.40 |
| A21 | 3 1/2 x 3 1/2 | 5/16 | 7.1 | 2.09 | .99 | 2.4[illegible]15 | .98 |
| " | " | 3/8 | 8.4 | 2.48 | 1.01 | 2.8[illegible]37 | 1.15 |
| " | " | 7/16 | 9.8 | 2.87 | 1.04 | 3.2[illegible]26 | 1.32 |
| " | " | 1/2 | 11.1 | 3.25 | 1.06 | 3.6[illegible]64 | 1.49 |
| " | " | 9/16 | 12.3 | 3.62 | 1.08 | 3.9[illegible]99 | 1.65 |
| " | " | 5/8 | 13.5 | 3.98 | 1.10 | 4.3[illegible]33 | 1.8[illegible] |
| " | " | 11/16 | 14.8 | 4.34 | 1.12 | 4.7[illegible]65 | 1.9[illegible] |
| " | " | 3/4 | 15.9 | 4.69 | 1.15 | 4.[illegible]96 | 2.1[illegible] |
| " | " | 13/16 | 17.1 | 5.03 | 1.17 | 5.[illegible]25 | 2.3[illegible] |
| " | " | 7/8 | 18.3 | 5.36 | 1.19 | 5.[illegible]53 | |
| A23 | 4 x 4 | 5/16 | 8.2 | 2.40 | 1.12 | [illegible].71 | 1.[illegible] |
| " | " | 3/8 | 9.7 | 2.86 | 1.14 | [illegible].36 | 1.[illegible] |
| " | " | 7/16 | 11.3 | 3.31 | 1.16 | [illegible].97 | 1.[illegible] |
| " | " | 1/2 | 12.8 | 3.75 | 1.18 | [illegible].56 | 1.[illegible] |
| " | " | 9/16 | 14.2 | 4.18 | 1.21 | [illegible].12 | 2.[illegible] |
| " | " | 5/8 | 15.7 | 4.61 | 1.23 | [illegible].66 | 2.[illegible] |
| " | " | 11/16 | 17.1 | 5.03 | 1.25 | [illegible].17 | 2.[illegible] |
| " | " | 3/4 | 18.5 | 5.44 | 1.27 | [illegible].66 | 3.[illegible] |
| " | " | 13/16 | 19.9 | 5.84 | 1.29 | [illegible].14 | 3.[illegible] |
| " | " | 7/8 | 21.2 | 6.23 | 1.31 | [illegible].59 | |
| A27 | 6 x 6 | 3/8 | 14.8 | 4.36 | 1.64 | 1[illegible].39 | 3.[illegible] |
| " | " | 7/16 | 17.2 | 5.06 | 1.66 | 1[illegible].68 | 4.[illegible] |
| " | " | 1/2 | 19.6 | 5.75 | 1.68 | 1[illegible].91 | 4.[illegible] |
| " | " | 9/16 | 21.9 | 6.43 | 1.71 | 2[illegible].07 | 5.[illegible] |
| " | " | 5/8 | 24.2 | 7.11 | 1.73 | 2[illegible].16 | 5.[illegible] |
| " | " | 11/16 | 26.4 | 7.78 | 1.75 | 2[illegible].19 | 6.[illegible] |
| " | " | 3/4 | 28.7 | 8.44 | 1.78 | 2[illegible].15 | 6.[illegible] |
| " | " | 13/16 | 30.9 | 9.09 | 1.80 | 3[illegible].06 | 7.[illegible] |
| " | " | 7/8 | 33.1 | 9.73 | 1.82 | 3[illegible].92 | 7.[illegible] |
| " | " | 15/16 | 35.3 | 10.37 | 1.84 | 3[illegible].72 | 8.[illegible] |
| " | " | 1 | 37.4 | 11.00 | 1.86 | 3[illegible].46 | 8.[illegible] |

# PROPERTIES OF STANDARD ANGLES.

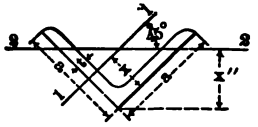
## EQUAL LEGS.




| 9 | 10 | 11 | 12 | 13 | 1 |
|---|---|---|---|---|---|
| lius of ration 1-1. | Distance of Center of Gravity from External Apex. | Least Moment of Inertia Axis 2-2. | Section Modulus Axis 2-2. | Least Radius of Gyration Axis 2-2. | Section Number. |
| r | x'' | I'' | S'' | r'' | |
| hes. | Inches. | Inches.[4] | Inches.[3] | Inches. | |
| 3 | 1.19 | .50 | .42 | .59 | A19 |
| 2 | 1.22 | .61 | .50 | .59 | " |
| 1 | 1.26 | .72 | .57 | .58 | " |
| 1 | 1.29 | .82 | .64 | .58 | " |
| 0 | 1.32 | .92 | .70 | .58 | " |
| 9 | 1.35 | 1.02 | .76 | .58 | " |
| 8 | 1.38 | 1.12 | .81 | .58 | " |
| 8 | 1.41 | 1.22 | .86 | .58 | " |
| 8 | 1.40 | .99 | .71 | .69 | A21 |
| 7 | 1.43 | 1.16 | .81 | .68 | " |
| 7 | 1.46 | 1.33 | .91 | .68 | " |
| 6 | 1.50 | 1.50 | 1.00 | .68 | " |
| 5 | 1.53 | 1.66 | 1.09 | .68 | " |
| 4 | 1.56 | 1.82 | 1.17 | .68 | " |
| 4 | 1.59 | 1.97 | 1.24 | .67 | " |
| 3 | 1.62 | 2.13 | 1.31 | .67 | " |
| 2 | 1.65 | 2.28 | 1.38 | .67 | " |
| 2 | 1.68 | 2.43 | 1.45 | .67 | " |
| 4 | 1.58 | 1.50 | .95 | .79 | A23 |
| 3 | 1.61 | 1.77 | 1.10 | .79 | " |
| 3 | 1.64 | 2.02 | 1.23 | .78 | " |
| 2 | 1.67 | 2.28 | 1.36 | .78 | " |
| 1 | 1.71 | 2.52 | 1.48 | .78 | " |
| 0 | 1.74 | 2.76 | 1.59 | .77 | " |
| 9 | 1.77 | 3.00 | 1.70 | .77 | " |
| 9 | 1.80 | 3.23 | 1.80 | .77 | " |
| 8 | 1.83 | 3.46 | 1.89 | .77 | " |
| 7 | 1.86 | 3.69 | 1.99 | .77 | " |
| 8 | 2.32 | 6.19 | 2.67 | 1.19 | A27 |
| 7 | 2.34 | 7.13 | 3.04 | 1.19 | " |
| 6 | 2.38 | 8.04 | 3.37 | 1.18 | " |
| 5 | 2.41 | 8.94 | 3.70 | 1.18 | " |
| 4 | 2.45 | 9.81 | 4.01 | 1.17 | " |
| 3 | 2.48 | 10.67 | 4.31 | 1.17 | " |
| 3 | 2.51 | 11.52 | 4.59 | 1.17 | " |
| 2 | 2.54 | 12.35 | 4.86 | 1.17 | " |
| 1 | 2.57 | 13.17 | 5.12 | 1.16 | " |
| 0 | 2.60 | 13.98 | 5.37 | 1.16 | " |
| 0 | 2.64 | 14.78 | 5.61 | 1.16 | " |

# PROPERTIES OF SPECIAL ANGLES.

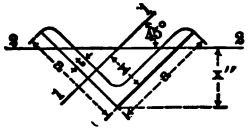
## EQUAL LEGS.




| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Section Number. | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Distance of Center of Gravity from Back of Flange. | Moment of Inertia Axis 1-1. | Section Modulus Axis 1-1. |
| | a x a | t | | A | x | I | S |
| | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches.$^4$ | Inches.$^3$ |
| A61 | 1½ x 1½ | ¼ | 1.23 | .36 | .42 | .08 | .073 |
| " | " | 3/16 | 1.79 | .53 | .44 | .11 | .104 |
| A65 | 1½ x 1½ | 5/32 | 2.07 | .61 | .45 | .12 | .119 |
| A41 | 2¼ x 2¼ | 3/16 | 2.7 | .81 | .63 | .39 | .24 |
| " | " | ¼ | 3.6 | 1.06 | .65 | .50 | .32 |
| " | " | 5/16 | 4.5 | 1.31 | .68 | .61 | .39 |
| " | " | 3/8 | 5.3 | 1.55 | .70 | .70 | .45 |
| " | " | 7/16 | 6.1 | 1.78 | .72 | .79 | .52 |
| A67 | 2¼ x 2¼ | 5/16 | 4.5 | 1.31 | .68 | .61 | .39 |
| A43 | 2¾ x 2¾ | 3/16 | 3.4 | 1.00 | .76 | .73 | .37 |
| " | " | ¼ | 4.5 | 1.31 | .78 | .95 | .48 |
| " | " | 5/16 | 5.5 | 1.62 | .80 | 1.15 | .59 |
| " | " | 3/8 | 6.5 | 1.92 | .82 | 1.33 | .69 |
| " | " | 7/16 | 7.5 | 2.21 | .85 | 1.51 | .79 |
| " | " | ½ | 8.5 | 2.50 | .87 | 1.67 | .89 |
| A45 | 4½ x 4½ | 5/16 | 9.2 | 2.71 | 1.24 | 5.36 | 1.64 |
| " | " | 3/8 | 11.0 | 3.23 | 1.26 | 6.30 | 1.95 |
| " | " | 7/16 | 12.7 | 3.75 | 1.29 | 7.20 | 2.24 |
| " | " | ½ | 14.5 | 4.25 | 1.31 | 8.07 | 2.53 |
| " | " | 9/16 | 16.1 | 4.75 | 1.33 | 8.91 | 2.81 |
| " | " | 5/8 | 17.8 | 5.23 | 1.35 | 9.71 | 3.09 |
| " | " | 11/16 | 19.5 | 5.71 | 1.38 | 10.48 | 3.35 |
| A47 | 5 x 5 | 5/8 | 12.3 | 3.61 | 1.39 | 8.74 | 2.42 |
| " | " | 11/16 | 14.2 | 4.18 | 1.41 | 10.02 | 2.79 |
| " | " | ½ | 16.2 | 4.75 | 1.43 | 11.25 | 3.16 |
| " | " | 13/16 | 18.1 | 5.31 | 1.46 | 12.44 | 3.51 |
| " | " | 7/8 | 19.9 | 5.86 | 1.48 | 13.58 | 3.86 |
| " | " | 15/16 | 21.8 | 6.40 | 1.50 | 14.68 | 4.20 |

# PROPERTIES OF SPECIAL ANGLES.

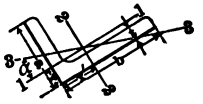
## EQUAL LEGS.




| 9 | 10 | 11 | 12 | 13 | 1 |
|---|---|---|---|---|---|
| Radius of Gyration Axis 1-1. | Distance of Center of Gravity from External Apex. | Least Moment of Inertia Axis 2-2. | Section Modulus Axis 2 2. | Least Radius of Gyration Axis 2-2. | Section Number |
| r | x'' | I'' | S'' | r'' | |
| Inches. | Inches. | Inches.$^4$ | Inches.$^3$ | Inches. | |
| .47 | .60 | .031 | .053 | .30 | A61 |
| .46 | .63 | .045 | .072 | .29 | " |
| .45 | .64 | .051 | .080 | .29 | A65 |
| .70 | .89 | .16 | .18 | .44 | A41 |
| .69 | .92 | .21 | .22 | .44 | " |
| .68 | .96 | .25 | .26 | .44 | " |
| .67 | .99 | .29 | .30 | .43 | " |
| .67 | 1.02 | .33 | .33 | .43 | " |
| .68 | .96 | .25 | .26 | .44 | A67 |
| .86 | 1.07 | .30 | .28 | .54 | A43 |
| .85 | 1.10 | .38 | .35 | .54 | " |
| .84 | 1.13 | .47 | .41 | .54 | " |
| .83 | 1.17 | .55 | .47 | .53 | " |
| .83 | 1.20 | .63 | .52 | .53 | " |
| .82 | 1.23 | .70 | .57 | .53 | " |
| 1.40 | 1.75 | 2.16 | 1.23 | .89 | A45 |
| 1.40 | 1.79 | 2.54 | 1.42 | .89 | " |
| 1.39 | 1.82 | 2.92 | 1.61 | .88 | " |
| 1.38 | 1.85 | 3.29 | 1.78 | .88 | " |
| 1.37 | 1.88 | 3.64 | 1.94 | .88 | " |
| 1.36 | 1.91 | 3.99 | 2.03 | .87 | " |
| 1.35 | 1.95 | 4.34 | 2.23 | .87 | " |
| 1.56 | 1.96 | 3.53 | 1.79 | .99 | A47 |
| 1.55 | 2.00 | 4.05 | 2.03 | .98 | " |
| 1.54 | 2.03 | 4.56 | 2.25 | .98 | " |
| 1.53 | 2.06 | 5.06 | 2.46 | .98 | " |
| 1.52 | 2.09 | 5.55 | 2.66 | .97 | " |
| 1.51 | 2.12 | 6.03 | 2.84 | .97 | " |

# PROPERTIES OF STANDARD ANGLES.

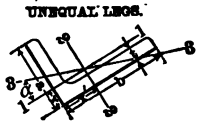
UNEQUAL LEGS.



| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Section Number. | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Distance of Center of Gravity from Back of Longer Flange. | Moment of Inertia Axis 1-1. |
| | b x a | t | | A | x | I |
| | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches.$^4$ |
| A91 | 2½ x 2 | 1/4 | 2.7 | .81 | .51 | .29 |
| " | " | 5/16 | 3.6 | 1.06 | .54 | .37 |
| " | " | 3/8 | 4.5 | 1.31 | .56 | .45 |
| " | " | 7/16 | 5.3 | 1.55 | .58 | .51 |
| " | " | 1/2 | 6.1 | 1.78 | .60 | .58 |
| " | " | 9/16 | 6.8 | 2.00 | .63 | .64 |
| " | " | 5/8 | 7.6 | 2.21 | .65 | .69 |
| A93 | 3 x 2½ | 1/4 | 4.5 | 1.31 | .66 | .74 |
| " | " | 5/16 | 5.5 | 1.62 | .68 | .90 |
| " | " | 3/8 | 6.5 | 1.92 | .71 | 1.04 |
| " | " | 7/16 | 7.5 | 2.21 | .73 | 1.18 |
| " | " | 1/2 | 8.5 | 2.50 | .75 | 1.30 |
| " | " | 9/16 | 9.4 | 2.78 | .77 | 1.42 |
| " | " | 5/8 | 10.4 | 3.05 | .79 | 1.53 |
| A95 | 3½ x 2½ | 1/4 | 4.9 | 1.44 | .61 | .78 |
| " | " | 5/16 | 6.0 | 1.78 | .64 | .94 |
| " | " | 3/8 | 7.2 | 2.11 | .66 | 1.09 |
| " | " | 7/16 | 8.3 | 2.43 | .68 | 1.23 |
| " | " | 1/2 | 9.4 | 2.75 | .70 | 1.36 |
| " | " | 9/16 | 10.4 | 3.06 | .73 | 1.49 |
| " | " | 5/8 | 11.4 | 3.36 | .75 | 1.61 |
| " | " | 11/16 | 12.4 | 3.65 | .77 | 1.72 |
| " | " | 3/4 | 13.4 | 3.94 | .79 | 1.83 |
| A97 | 3½ x 3 | 5/16 | 6.6 | 1.93 | .81 | 1.58 |
| " | " | 3/8 | 7.8 | 2.30 | .83 | 1.85 |
| " | " | 7/16 | 9.0 | 2.65 | .85 | 2.09 |
| " | " | 1/2 | 10.2 | 3.00 | .88 | 2.33 |
| " | " | 9/16 | 11.4 | 3.34 | .90 | 2.55 |
| " | " | 5/8 | 12.5 | 3.67 | .92 | 2.76 |
| " | " | 11/16 | 13.6 | 4.00 | .94 | 2.96 |
| " | " | 3/4 | 14.7 | 4.31 | .96 | 3.15 |
| " | " | 13/16 | 15.7 | 4.62 | .98 | 3.33 |
| " | " | 7/8 | 16.8 | 4.92 | 1.00 | 3.50 |
| A99 | 4 x 3 | 5/16 | 7.1 | 2.09 | .76 | 1.65 |
| " | " | 3/8 | 8.4 | 2.48 | .78 | 1.92 |
| " | " | 7/16 | 9.8 | 2.87 | .80 | 2.1 |
| " | " | 1/2 | 11.1 | 3.25 | .83 | 2.4 |
| " | " | 9/16 | 12.3 | 3.62 | .85 | 2.6 |
| " | " | 5/8 | 13.5 | 3.98 | .87 | 2.8 |
| " | " | 11/16 | 14.8 | 4.34 | .89 | 3.0 |
| " | " | 3/4 | 15.9 | 4.69 | .92 | 3.2 |
| " | " | 13/16 | 17.1 | 5.03 | .94 | 3. |
| " | " | 7/8 | 18.3 | 5.36 | .96 | 3. |

# PROPERTIES OF STANDARD ANGLE

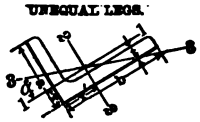
UNEQUAL LEGS.



| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Section Number. | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Distance of Center of Gravity from Back of Longer Flange. | Moment of Inertia Axis |
| | b i a | t | | A | x | I |
| | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches |
| A101 | 5 x 3 | 5/16 | 8.2 | 2.40 | .68 | 1.7 |
| " | " | 3/8 | 9.7 | 2.86 | .70 | 2.0 |
| " | " | 7/16 | 11.3 | 3.31 | .73 | 2.3 |
| " | " | 1/2 | 12.8 | 3.75 | .75 | 2.5 |
| " | " | 9/16 | 14.2 | 4.18 | .77 | 2.8 |
| " | " | 5/8 | 15.7 | 4.61 | .80 | 3.0 |
| " | " | 11/16 | 17.1 | 5.03 | .82 | 3.2 |
| " | " | 3/4 | 18.5 | 5.44 | .84 | 3.5 |
| " | " | 13/16 | 19.9 | 5.84 | .86 | 3.7 |
| " | " | 7/8 | 21.2 | 6.23 | .88 | 3.9 |
| A103 | 5 x 3½ | 5/16 | 8.7 | 2.56 | .84 | 2.7 |
| " | " | 3/8 | 10.4 | 3.05 | .86 | 3.1 |
| " | " | 7/16 | 12.0 | 3.53 | .88 | 3.6 |
| " | " | 1/2 | 13.6 | 4.00 | .91 | 4.0 |
| " | " | 9/16 | 15.2 | 4.46 | .93 | 4.4 |
| " | " | 5/8 | 16.7 | 4.92 | .95 | 4.8 |
| " | " | 11/16 | 18.3 | 5.37 | .97 | 5.2 |
| " | " | 3/4 | 19.8 | 5.81 | 1.00 | 5.5 |
| " | " | 13/16 | 21.2 | 6.25 | 1.02 | 5.8 |
| " | " | 7/8 | 22.7 | 6.67 | 1.04 | 6.2 |
| " | " | 15/16 | 24.1 | 7.09 | 1.06 | 6.5 |
| A105 | 6 x 3½ | 3/8 | 11.6 | 3.42 | .79 | 3.3 |
| " | " | 7/16 | 13.5 | 3.96 | .81 | 3.8 |
| " | " | 1/2 | 15.3 | 4.50 | .83 | 4.2 |
| " | " | 9/16 | 17.1 | 5.03 | .86 | 4.6 |
| " | " | 5/8 | 18.9 | 5.55 | .88 | 5.0 |
| " | " | 11/16 | 20.6 | 6.06 | .90 | 5.4 |
| " | " | 3/4 | 22.3 | 6.56 | .93 | 5.8 |
| " | " | 13/16 | 24.0 | 7.06 | .95 | 6.2 |
| " | " | 7/8 | 25.7 | 7.55 | .97 | 6.5 |
| " | " | 15/16 | 27.3 | 8.03 | .99 | 6.8 |
| " | " | 1 | 28.9 | 8.50 | 1.01 | 7.2 |
| A107 | 6 x 4 | 3/8 | 12.3 | 3.61 | .94 | 4.9 |
| " | " | 7/16 | 14.2 | 4.18 | .96 | 5.6 |
| " | " | 1/2 | 16.2 | 4.75 | .99 | 6.2 |
| " | " | 9/16 | 18.1 | 5.31 | 1.01 | 6.9 |
| " | " | 5/8 | 19.9 | 5.86 | 1.03 | 7.5 |
| " | " | 11/16 | 21.8 | 6.40 | 1.06 | 8.1 |
| " | " | 3/4 | 23.6 | 6.94 | 1.08 | 8.6 |
| " | " | 13/16 | 25.4 | 7.46 | 1.10 | 9.2 |
| " | " | 7/8 | 27.2 | 7.98 | 1.12 | 9.7 |
| " | " | 15/16 | 28.9 | 8.50 | 1.14 | 10.2 |
| " | " | 1 | 30.6 | 9.00 | 1.17 | 10.7 |

# PROPERTIES OF STANDARD ANGLES.

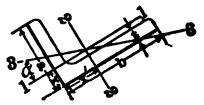
UNEQUAL LEGS.



| 10 | 11 | 12 | 13 | 14 | 15 | 1 |
|---|---|---|---|---|---|---|
| Distance of Center of Gravity from Back of Shorter Flange. | Moment of Inertia Axis 2-2. | Section Modulus Axis 2-2. | Radius of Gyration Axis 2-2. | Tangent of Angle | Least Radius of Gyration Axis 3-3. | Section Number. |
| $x'$ | $I'$ | $S'$ | $r'$ | $\alpha$ | $r''$ | |
| Inches. | Inches.[4] | Inches.[3] | Inches. | | Inches. | |
| 1.68 | 6.26 | 1.89 | 1.61 | .368 | .66 | A101 |
| 1.70 | 7.37 | 2.24 | 1.61 | .364 | .65 | " |
| 1.73 | 8.43 | 2.58 | 1.60 | .361 | .65 | " |
| 1.75 | 9.45 | 2.91 | 1.59 | .357 | .65 | " |
| 1.77 | 10.43 | 3.23 | 1.58 | .353 | .65 | " |
| 1.80 | 11.37 | 3.55 | 1.57 | .349 | .64 | " |
| 1.82 | 12.28 | 3.86 | 1.56 | .345 | .64 | " |
| 1.84 | 13.15 | 4.16 | 1.55 | .340 | .64 | " |
| 1.86 | 13.98 | 4.46 | 1.55 | .336 | .64 | " |
| 1.88 | 14.78 | 4.75 | 1.54 | .331 | .64 | " |
| 1.59 | 6.60 | 1.94 | 1.61 | .489 | .77 | A103 |
| 1.61 | 7.78 | 2.29 | 1.60 | .485 | .76 | " |
| 1.63 | 8.90 | 2.64 | 1.59 | .482 | .76 | " |
| 1.66 | 9.99 | 2.99 | 1.58 | .479 | .75 | " |
| 1.68 | 11.03 | 3.32 | 1.57 | .476 | .75 | " |
| 1.70 | 12.03 | 3.65 | 1.56 | .472 | .75 | " |
| 1.72 | 12.99 | 3.97 | 1.56 | .468 | .75 | " |
| 1.75 | 13.92 | 4.28 | 1.55 | .464 | .75 | " |
| 1.77 | 14.81 | 4.58 | 1.54 | .460 | .75 | " |
| 1.79 | 15.67 | 4.88 | 1.53 | .455 | .75 | " |
| 1.81 | 16.49 | 5.17 | 1.53 | .451 | .75 | " |
| 2.04 | 12.86 | 3.24 | 1.94 | .350 | .77 | A105 |
| 2.06 | 14.76 | 3.75 | 1.93 | .347 | .76 | " |
| 2.08 | 16.59 | 4.24 | 1.92 | .344 | .76 | " |
| 2.11 | 18.37 | 4.72 | 1.91 | .341 | .75 | " |
| 2.13 | 20.08 | 5.19 | 1.90 | .338 | .75 | " |
| 2.15 | 21.74 | 5.65 | 1.89 | .334 | .75 | " |
| 2.18 | 23.34 | 6.10 | 1.89 | .331 | .75 | " |
| 2.20 | 24.89 | 6.55 | 1.88 | .327 | .75 | " |
| 2.22 | 26.39 | 6.98 | 1.87 | .323 | .75 | " |
| 2.24 | 27.84 | 7.41 | 1.86 | .320 | .75 | " |
| 2.26 | 29.15 | 7.80 | 1.85 | .317 | .75 | " |
| 1.94 | 13.47 | 3.32 | 1.93 | .446 | .88 | A107 |
| 1.96 | 15.46 | 3.83 | 1.92 | .443 | .87 | " |
| 1.99 | 17.40 | 4.33 | 1.91 | .440 | .87 | " |
| 2.01 | 19.26 | 4.83 | 1.90 | .438 | .87 | " |
| 2.03 | 21.07 | 5.31 | 1.90 | .434 | .86 | " |
| 2.06 | 22.82 | 5.78 | 1.89 | .431 | .86 | " |
| 2.08 | 24.51 | 6.25 | 1.88 | .428 | .86 | " |
| 2.10 | 26.15 | 6.70 | 1.87 | .425 | .86 | " |
| 2.12 | 27.73 | 7.15 | 1.86 | .421 | .86 | " |
| *2.14* | *29.26* | 7.59 | 1.86 | .418 | .86 | " |
| *2.17* | *30.75* | 8.02 | 1.85 | .414 | 86 | " |

## PROPERTIES OF SPECIAL ANGLES.

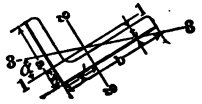
UNEQUAL LEGS.



| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Section Number. | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Distance of Center of Gravity from Back of Longer Flange. | Moment of Inertia Axis 1-1. |
| | b x a | t | | A | x | I |
| | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches.$^4$ |
| A170 | 1⅜ x 1⅛ | ⅛ | 0.93 | .27 | .24 | .020 |
| A165 | 1¾ x 1⅛ | 3/16 | 2.72 | .80 | .33 | .073 |
| A121 | 2 x 1⅜ | 3/16 | 2.03 | .60 | .35 | .10 |
| " | " | ¼ | 2.66 | .78 | .37 | .12 |
| " | " | 5/16 | 3.25 | .96 | .39 | .14 |
| " | " | ⅜ | 3.83 | 1.13 | .42 | .16 |
| " | " | 7/16 | 4.37 | 1.29 | .44 | .18 |
| A123 | 2 x 1½ | 3/16 | 2.11 | .62 | .39 | .12 |
| " | " | ¼ | 2.76 | .81 | .41 | .15 |
| " | " | 5/16 | 3.39 | 1.00 | .44 | .18 |
| " | " | ⅜ | 3.98 | 1.17 | .46 | .21 |
| " | " | 7/16 | 4.56 | 1.34 | .48 | .23 |
| A155 | 2 3/16 x 1 3/16 | 11/64 | 2.02 | .59 | .30 | .08 |
| A125 | 2⅛ x 1¼ | 3/16 | 2.27 | .67 | .28 | .07 |
| " | " | ¼ | 2.98 | .88 | .30 | .09 |
| " | " | 5/16 | 3.65 | 1.07 | .33 | .11 |
| " | " | ⅜ | 4.30 | 1.27 | .35 | .13 |
| " | " | 7/16 | 4.93 | 1.45 | .37 | .14 |
| A127 | 2⅛ x 1½ | 3/16 | 2.43 | .71 | .35 | .13 |
| " | " | ¼ | 3.19 | .94 | .38 | .16 |
| " | " | 5/16 | 3.92 | 1.15 | .40 | .19 |
| " | " | ⅜ | 4.62 | 1.36 | .42 | .22 |
| " | " | 7/16 | 5.30 | 1.56 | .44 | .24 |
| A161 | 2½ x 1¾ | 3/16 | 2.6 | .76 | .43 | .20 |
| " | " | ¼ | 3.4 | 1.00 | .45 | .25 |
| A143 | 2½ x 2¼ | ¾ | 10.2 | 3.00 | .80 | 1.19 |
| A128 | 2¾ x 1½ | 3/16 | 2.6 | 0.76 | .34 | .13 |
| " | " | ¼ | 3.4 | 1.00 | .36 | .17 |
| " | " | 5/16 | 4.2 | 1.23 | .38 | .20 |
| " | " | ⅜ | 4.9 | 1.45 | .41 | .22 |
| " | " | 7/16 | 5.7 | 1.67 | .43 | .25 |

# PROPERTIES OF SPECIAL ANGLES.

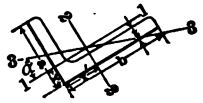
UNEQUAL LEGS.




| 10 | 11 | 12 | 13 | 14 | 15 | 1 |
|---|---|---|---|---|---|---|
| Distance of Center of Gravity from Back of Shorter Flange. | Moment of Inertia Axis 2-2. | Section Modulus Axis 2-2. | Radius of Gyration Axis 2-2. | Tangent of Angle | Least Radius of Gyration Axis 3-3. | Section Number. |
| $x'$ | $I'$ | $S'$ | $r'$ | $\alpha$ | $r''$ | |
| Inches. | Inches.$^4$ | Inches.$^3$ | Inches. | | Inches. | |
| .46 | .053 | .057 | .44 | .458 | .20 | A170 |
| .65 | .140 | .127 | .42 | .104 | .30 | A165 |
| .66 | .24 | .18 | .63 | .475 | .31 | A121 |
| .68 | .31 | .23 | .63 | .455 | .30 | " |
| .71 | .37 | .28 | .62 | .445 | .29 | " |
| .73 | .42 | .33 | .61 | .434 | .29 | " |
| .75 | .47 | .38 | .60 | .421 | .30 | " |
| .64 | .25 | .18 | .63 | .551 | .32 | A123 |
| .66 | .32 | .24 | .62 | .543 | .32 | " |
| .69 | .38 | .29 | .62 | .534 | .32 | " |
| .71 | .43 | .34 | .61 | .524 | .32 | " |
| .73 | .48 | .38 | .60 | .512 | .32 | " |
| .80 | .33 | .22 | .74 | .330 | .29 | A155 |
| .91 | .43 | .27 | .80 | .264 | .27 | A125 |
| .93 | .55 | .35 | .79 | .256 | .27 | " |
| .95 | .66 | .43 | .79 | .247 | .26 | " |
| .97 | .77 | .50 | .78 | .238 | .26 | " |
| 1.00 | .86 | .57 | .77 | .228 | .27 | " |
| .85 | .46 | .28 | .80 | .364 | .33 | A127 |
| .88 | .59 | .36 | .79 | .357 | .32 | " |
| .90 | .71 | .44 | .79 | .349 | .32 | " |
| .92 | .82 | .52 | .78 | .340 | .32 | " |
| .94 | .92 | .59 | .77 | .331 | .32 | " |
| .81 | .49 | .29 | .80 | .486 | .38 | A161 |
| .83 | .62 | .37 | .79 | .479 | .38 | " |
| .92 | 1.57 | .99 | .72 | .763 | .47 | A143 |
| .96 | .60 | .33 | .89 | .309 | .33 | A128 |
| .98 | .77 | .44 | .88 | .302 | .32 | " |
| 1.01 | .93 | .53 | .87 | .295 | .32 | " |
| 1.03 | 1.08 | .63 | .86 | .287 | .32 | " |
| 1.05 | 1.21 | .72 | .85 | .279 | .32 | " |

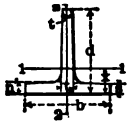
# PROPERTIES OF SPECIAL ANGLES.

UNEQUAL LEGS.



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|
| Section Number. | Dimensions. | Thickness. | Weight per Foot. | Area of Section. | Distance of Center of Gravity from Back of Longer Flange. | Moment of Inertia Axis 1-1. | Se Mo Ax |
| | b x a | t | | A | x | I | |
| | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches.4 | In |
| A129 | 3 x 2 | 3/16 | 3.1 | .90 | .47 | .31 | |
| " | " | 1/4 | 4.0 | 1.19 | .49 | .39 | |
| " | " | 5/16 | 5.0 | 1.46 | .51 | .47 | |
| " | " | 3/8 | 5.9 | 1.73 | .54 | .54 | |
| " | " | 7/16 | 6.8 | 2.00 | .56 | .61 | |
| " | " | 1/2 | 7.7 | 2.25 | .58 | .67 | |
| A145 | 3 x 2 1/16 | 9/16 | 9.8 | 2.88 | .84 | 1.76 | |
| A147 | 3 x 2 1/16 | 9/16 | 10.0 | 2.95 | .88 | 2.01 | 1 |
| A131 | 4 x 3 1/2 | 5/16 | 7.6 | 2.25 | .93 | 2.55 | |
| " | " | 3/8 | 9.1 | 2.67 | .96 | 2.99 | 1 |
| " | " | 7/16 | 10.5 | 3.09 | .98 | 3.40 | 1 |
| " | " | 1/2 | 11.9 | 3.50 | 1.00 | 3.79 | 1 |
| " | " | 9/16 | 13.3 | 3.90 | 1.02 | 4.17 | 1 |
| " | " | 5/8 | 14.6 | 4.30 | 1.04 | 4.49 | 1 |
| " | " | 11/16 | 16.0 | 4.68 | 1.07 | 4.86 | 2 |
| A133 | 4 1/2 x 3 | 5/16 | 9.1 | 2.67 | .74 | 1.98 | |
| " | " | 7/16 | 10.5 | 3.09 | .76 | 2.25 | 1 |
| " | " | 1/2 | 11.9 | 3.50 | .79 | 2.51 | 1 |
| " | " | 9/16 | 13.3 | 3.90 | .81 | 2.75 | 1 |
| " | " | 5/8 | 14.6 | 4.30 | .83 | 2.98 | 1 |
| " | " | 11/16 | 16.0 | 4.68 | .85 | 3.19 | 1 |
| A135 | 5 x 4 | 5/16 | 11.0 | 3.23 | 1.03 | 4.66 | 1 |
| " | " | 7/16 | 12.7 | 3.75 | 1.05 | 5.32 | 1 |
| " | " | 1/2 | 14.5 | 4.25 | 1.07 | 5.96 | 2 |
| " | " | 9/16 | 16.1 | 4.75 | 1.10 | 6.56 | 2 |
| " | " | 5/8 | 17.8 | 5.23 | 1.12 | 7.14 | 2 |
| " | " | 11/16 | 19.5 | 5.71 | 1.14 | 7.70 | 2 |
| A109 | 7 x 3 1/2 | 7/16 | 15.0 | 4.40 | .75 | 3.95 | 1 |
| " | " | 1/2 | 17.0 | 5.00 | .78 | 4.41 | 1 |
| " | " | 9/16 | 19.0 | 5.59 | .80 | 4.86 | 1 |
| " | " | 5/8 | 21.0 | 6.17 | .82 | 5.28 | 1 |
| " | " | 11/16 | 23.0 | 6.75 | .85 | 5.69 | 2 |
| " | " | 3/4 | 24.9 | 7.31 | .87 | 6.08 | 2 |
| " | " | 13/16 | 26.8 | 7.87 | .89 | 6.46 | 2 |
| " | " | 7/8 | 28.7 | 8.42 | .91 | 6.83 | 2 |
| " | " | 15/16 | 30.5 | 8.96 | .94 | 7.18 | 2 |
| " | " | 1 | 32.3 | 9.50 | .96 | 7.53 | 2 |

# PROPERTIES OF T-BARS.



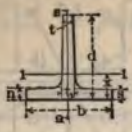

## EQUAL LEGS.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| Section Number. | Dimensions. | | | | Weight per Foot. | Area of Section. | Distance of Center of Gravity from Outside of Flange. | Moment of Inertia Axis 1-1. |
| | Width of Flange. | Depth of Bar. | Thickness of Flange. | Thickness of Stem. | | | | |
| | b | d | s to n′ | t to t′ | | A | x | I |
| | Inches. | Inches. | Inches. | Inches. | Pounds. | Sq. Ins. | Inches. | Inches.⁴ |
| T 5 | 1 | 1 | 1/8 to 5/32 | 1/8 to 5/32 | .89 | .26 | .29 | .02 |
| T181 | 1 1/8 | 1 1/8 | 3/16 " 7/32 | 5/32 " 7/32 | 1.39 | .41 | .33 | .04 |
| T183 | 1 3/16 | 1 3/16 | 3/16 " 1/4 | 5/32 " 7/32 | 1.53 | .45 | .34 | .05 |
| T187 | 1 1/4 | 1 1/4 | 3/16 " 1/4 | 5/32 " 1/4 | 1.61 | .47 | .36 | .06 |
| T189 | 1 3/8 | 1 3/8 | 3/16 " 1/4 | 5/32 " 1/4 | 1.85 | .54 | .39 | .08 |
| T 37 | 2 | 2 | 1/4 " 5/16 | 1/4 " 5/16 | 3.7 | 1.05 | .59 | .37 |
| T 39 | 2 | 2 | 5/16 " 3/8 | 5/16 " 3/8 | 4.3 | 1.26 | .61 | .43 |
| T 41 | 2 1/4 | 2 1/4 | 1/4 " 5/16 | 1/4 " 5/16 | 4.1 | 1.19 | .68 | .51 |
| T 49 | 2 1/2 | 2 1/2 | 5/16 " 3/8 | 5/16 " 3/8 | 5.5 | 1.60 | .73 | .87 |
| T 67 | 3 | 3 | 5/16 " 3/8 | 5/16 " 3/8 | 6.6 | 1.95 | .86 | 1.58 |
| T 69 | 3 | 3 | 3/8 " 7/16 | 3/8 " 7/16 | 7.8 | 2.27 | .88 | 1.82 |
| T 97 | 3 1/2 | 3 1/2 | 3/8 " 7/16 | 3/8 " 7/16 | 9.3 | 2.74 | .99 | 3.10 |
| T 42 | 2 1/4 | 2 1/4 | 5/16 " 3/8 | 5/16 " 3/8 | 4.9 | 1.45 | .67 | .64 |

## UNEQUAL LEGS.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T185 | 1 1/4 | 1 1/16 | 3/16 to 1/4 | 5/32 to 7/32 | 1.49 | .44 | .29 | .04 |
| T 22 | 2 1/2 | 1 1/4 | 3/16 " 9/32 | 3/16 " 5/16 | 2.9 | .84 | .30 | .08 |
| T 65 | 3 | 2 1/2 | 3/8 " 7/16 | 3/8 " 7/16 | 7.2 | 2.07 | .71 | 1.08 |
| T101 | 3 1/2 | 4 | 3/8 " 7/16 | 3/8 " 7/16 | 9.9 | 2.91 | 1.20 | 4.30 |
| *T169* | *5* | *3* | 1/2 " 9/16 | 13/32 " 5/8 | 13.6 | 3.93 | .72 | 2.42 |

# PROPERTIES OF T-BARS.



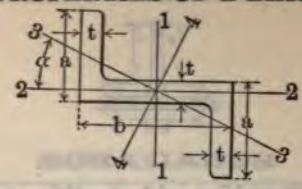

## EQUAL LEGS.

| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|
| | | | | | Coef. of Strength. | | |
| Section Modulus Axis 1-1. | Radius of Gyration Axis 1-1. | Moment of Inertia Axis 2-2. | Section Modulus Axis 2-2. | Radius of Gyration Axis 2-2. | For Fibre Stress of 16 000 lbs. per Square Inch. | For Fibre Stress of 12 500 lbs. per Square Inch. | Section Number. |
| S | r | I′ | S′ | r′ | F | F′ | |
| Inches.$^3$ | Inches. | Inches.$^4$ | Inches.$^3$ | Inches. | | | |
| .03 | .30 | .01 | .02 | .21 | 350 | 270 | T 5 |
| .05 | .32 | .02 | .04 | .25 | 560 | 440 | T181 |
| .06 | .33 | .03 | .05 | .26 | 630 | 490 | T183 |
| .07 | .35 | .03 | .05 | .27 | 700 | 550 | T187 |
| .08 | .39 | .05 | .07 | .29 | 890 | 690 | T189 |
| .26 | .59 | .18 | .18 | .42 | 2770 | 2160 | T 37 |
| .31 | .59 | .23 | .23 | .42 | 3330 | 2600 | T 39 |
| .32 | .65 | .24 | .21 | .45 | 3440 | 2690 | T 41 |
| .49 | .74 | .44 | .35 | .52 | 5250 | 4100 | T 49 |
| .74 | .90 | .75 | .50 | .62 | 7860 | 6140 | T 67 |
| .86 | .90 | .92 | .61 | .64 | 9180 | 7180 | T 69 |
| 1.23 | 1.08 | 1.42 | .81 | .73 | 13140 | 10260 | T 97 |
| .40 | .66 | .32 | .29 | .47 | 4290 | 3360 | T 42 |

## UNEQUAL LEGS.

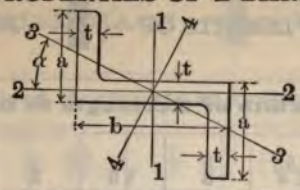
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| .05 | .29 | .03 | .01 | .28 | 500 | 390 | T185 |
| .09 | .31 | .28 | .22 | .58 | 930 | 730 | T 22 |
| .60 | .64 | .90 | .60 | .66 | 6400 | 5000 | T 65 |
| 1.54 | 1.23 | 1.42 | .81 | .70 | 16470 | 12860 | T101 |
| *1.06* | *.78* | *5.42* | *2.17* | 1.17 | 11340 | 8860 | T169 |

## PROPERTIES OF Z-BARS.




| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|
| Section Number. | Depth of Bar. | Length of Legs. | Thickness of Web and Legs. | W'ght per Foot. | Area of Section. | Moment of Inertia Axis 1-1. | Section Modulus Axis 1-1. | Radius of Gyration Axis 1-1. | Moment of Inertia Axis 2-2. | Section Modulus Axis 2-2. |
| | b | a | t | | A | I | S | r | I' | S' |
| | Inches. | Inches. | Inches. | Lbs. | Sq. Ins. | Inches.⁴ | Inches.³ | Inches | Inches.⁴ | Ins.³ |
| Z 5 | 3 | 2 1/16 | 1/4 | 6.7 | 1.97 | 2.87 | 1.92 | 1.21 | 2.81 | 1.10 |
| " | 3 1/16 | 2 1/4 | 5/16 | 8.4 | 2.48 | 3.64 | 2.38 | 1.21 | 3.64 | 1.40 |
| Z 9 | 3 | 2 1/16 | 3/8 | 9.7 | 2.86 | 3.85 | 2.57 | 1.16 | 3.92 | 1.57 |
| " | 3 1/16 | 2 1/4 | 5/16 | 11.4 | 3.36 | 4.57 | 2.98 | 1.17 | 4.75 | 1.88 |
| Z13 | 3 | 2 1/16 | 1/2 | 12.5 | 3.69 | 4.59 | 3.06 | 1.12 | 4.85 | 1.98 |
| " | 3 1/16 | 2 1/4 | 5/16 | 14.2 | 4.18 | 5.26 | 3.43 | 1.12 | 5.68 | 2.30 |
| Z21 | 4 | 3 1/16 | 1/4 | 8.2 | 2.41 | 6.28 | 3.14 | 1.62 | 4.23 | 1.44 |
| " | 4 1/16 | 3 1/8 | 5/16 | 10.3 | 3.03 | 7.94 | 3.91 | 1.62 | 5.46 | 1.84 |
| " | 4 1/16 | 3 3/16 | 3/8 | 12.4 | 3.66 | 9.63 | 4.67 | 1.62 | 6.77 | 2.26 |
| Z25 | 4 | 3 1/16 | 7/16 | 13.8 | 4.05 | 9.66 | 4.83 | 1.54 | 6.73 | 2.37 |
| " | 4 1/16 | 3 1/8 | 1/2 | 15.8 | 4.66 | 11.18 | 5.50 | 1.55 | 7.96 | 2.77 |
| " | 4 1/16 | 3 3/16 | 9/16 | 17.9 | 5.27 | 12.74 | 6.18 | 1.55 | 9.26 | 3.19 |
| Z29 | 4 | 3 1/16 | 5/8 | 18.9 | 5.55 | 12.11 | 6.05 | 1.48 | 8.73 | 3.18 |
| " | 4 1/16 | 3 1/8 | 11/16 | 20.9 | 6.14 | 13.52 | 6.65 | 1.48 | 9.95 | 3.58 |
| " | 4 1/16 | 3 3/16 | 3/4 | 23.0 | 6.75 | 14.97 | 7.26 | 1.49 | 11.24 | 4.00 |
| Z37 | 5 | 3 1/4 | 5/16 | 11.6 | 3.40 | 13.36 | 5.34 | 1.98 | 6.18 | 2.00 |
| " | 5 1/16 | 3 5/16 | 3/8 | 13.9 | 4.10 | 16.18 | 6.39 | 1.99 | 7.65 | 2.45 |
| " | 5 1/16 | 3 3/8 | 7/16 | 16.4 | 4.81 | 19.07 | 7.44 | 1.99 | 9.20 | 2.92 |
| Z41 | 5 | 3 1/4 | 1/2 | 17.9 | 5.25 | 19.19 | 7.68 | 1.91 | 9.05 | 3.03 |
| " | 5 1/16 | 3 5/16 | 9/16 | 20.2 | 5.94 | 21.83 | 8.62 | 1.92 | 10.51 | 3.47 |
| " | 5 1/16 | 3 3/8 | 5/8 | 22.6 | 6.64 | 24.53 | 9.57 | 1.92 | 12.06 | 3.94 |
| Z45 | 5 | 3 1/4 | 11/16 | 23.7 | 6.96 | 23.68 | 9.47 | 1.84 | 11.37 | 3.91 |
| " | 5 1/16 | 3 5/16 | 3/4 | 26.0 | 7.64 | 26.16 | 10.34 | 1.85 | 12.83 | 4.37 |
| " | 5 1/16 | 3 3/8 | 13/16 | 28.3 | 8.33 | 28.70 | 11.20 | 1.86 | 14.37 | 4.84 |
| Z53 | 6 | 3 1/2 | 3/8 | 15.6 | 4.59 | 25.32 | 8.44 | 2.35 | 9.11 | 2.75 |
| " | 6 1/16 | 3 5/8 | 7/16 | 18.3 | 5.39 | 29.80 | 9.83 | 2.35 | 10.94 | 3.27 |
| " | 6 1/16 | 3 3/8 | 1/2 | 21.0 | 6.19 | 34.36 | 11.22 | 2.36 | 12.87 | 3.81 |
| Z57 | 6 | 3 1/4 | 9/16 | 22.7 | 6.68 | 34.64 | 11.55 | 2.28 | 12.59 | 3.91 |
| " | 6 1/16 | 3 5/16 | 5/8 | 25.4 | 7.46 | 38.87 | 12.82 | 2.28 | 14.41 | 4.44 |
| " | 6 1/16 | 3 3/8 | 11/16 | 28.1 | 8.25 | 43.18 | 14.10 | 2.29 | 16.34 | 4.99 |
| Z61 | 6 | 3 1/2 | 3/4 | 29.3 | 8.63 | 42.12 | 14.04 | 2.21 | 15.44 | 4.94 |
| " | 6 1/16 | 3 5/8 | 13/16 | 31.9 | 9.39 | 46.13 | 15.22 | 2.22 | 17.27 | 5.47 |
| " | 6 1/16 | 3 3/8 | 7/8 | 34.6 | 10.17 | 50.22 | 16.40 | 2.22 | 19.18 | 6.05 |
| Z67 | 7 1/16 | 3 | 3/8 | 16.3 | 4.78 | 38.19 | 10.18 | 2.83 | 5.59 | 1.99 |
| Z73 | 8 | 3 | 3/8 | 16.9 | 4.97 | 44.64 | 11.16 | 3.00 | 5.60 | 1.99 |
| Z83 | 10 | 3 | 3/8 | 19.4 | 5.72 | 76.87 | 15.37 | 3.67 | 5.60 | 1.99 |

## PROPERTIES OF Z-BARS.




| 13 | 14 | 15 | 16 | 17 | 18 | 1 |
|---|---|---|---|---|---|---|
| | | Coef. of Strength. | | Coef. of Deflection. | | |
| Tangent of Angle $\alpha$ | Least Radius of Gyration Axis 3-3. $r''$ Inches. | For Fibre Stress of 16 000 Pounds per Square Inch. F | For Fibre Stress of 12500 Pounds per Square Inch. F′ | Uniform Load. N | Center Load. N′ | Section Number. |
| .986 | .55 | 20400 | 16000 | .000270 | .000432 | Z 5 |
| 1.000 | .55* | 25400 | 19800 | .000213 | .000341 | " |
| .990 | .54* | 27400 | 21400 | .000201 | .000322 | Z 9 |
| .975 | .55* | 31800 | 24800 | .000170 | .000272 | " |
| .965 | .53* | 32600 | 25500 | .000169 | .000271 | Z13 |
| .951 | .54* | 36600 | 28600 | .000148 | .000236 | " |
| .778 | .67 | 33500 | 26200 | .000123 | .000198 | Z21 |
| .788 | .68 | 41700 | 32600 | .000098 | .000156 | " |
| .798 | .69 | 49800 | 38900 | .000081 | .000129 | " |
| .794 | .66 | 51500 | 40200 | .000080 | .000129 | Z25 |
| .804 | .67 | 58700 | 45900 | .000069 | .000111 | " |
| .814 | .68 | 65900 | 51500 | .000061 | .000097 | " |
| .808 | .65 | 64600 | 50500 | .000064 | .000103 | Z29 |
| .818 | .67 | 71000 | 55500 | .000057 | .000092 | " |
| .828 | .68 | 77400 | 60500 | .000052 | .000083 | " |
| .611 | .75 | 57000 | 44500 | .000058 | .000093 | Z37 |
| .619 | .76 | 68200 | 53300 | .000048 | .000077 | " |
| .628 | .76 | 79400 | 62000 | .000041 | .000065 | " |
| .616 | .74 | 81900 | 64000 | .000040 | .000065 | Z41 |
| .623 | .75 | 92000 | 71900 | .000036 | .000057 | " |
| .631 | .76 | 102100 | 79800 | .000032 | .000051 | " |
| .619 | .73 | 101000 | 78900 | .000033 | .000052 | Z45 |
| .626 | .74 | 110200 | 86100 | .000030 | .000047 | " |
| .633 | .76 | 119500 | 93300 | .000027 | .000043 | " |
| .519 | .83 | 90000 | 70300 | .000031 | .000049 | Z53 |
| .526 | .83 | 104900 | 81900 | .000026 | .000042 | " |
| .532 | .84 | 119700 | 93500 | .000023 | .000036 | " |
| .520 | .81 | 123200 | 96200 | .000022 | .000036 | Z57 |
| .526 | .82 | 136800 | 106800 | .000020 | .000032 | " |
| .532 | .84 | 150400 | 117500 | .000018 | .000029 | " |
| .519 | .81 | 149800 | 117000 | .000018 | .000029 | Z61 |
| .525 | .82 | 162300 | 126800 | .000017 | .000027 | " |
| .530 | .83 | 174900 | 136700 | .000015 | .000025 | " |
| .29 | .72 | 108600 | 84800 | .000020 | .000033 | Z67 |
| .27 | .72 | 119000 | 93000 | .000017 | .000028 | Z73 |
| .19 | .71 | 163900 | 128100 | .000010 | .000016 | Z83 |

* *In these cases the minimum* value of $r''$ corresponds to Neutral Axis 4-4.

## MOMENTS OF INERTIA OF ▮ RECTANGL

| Depth in Inches. | Width of Rectangle in Inches. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 |
| 2 | .17 | .21 | .25 | .29 | .33 | .38 | |
| 3 | .56 | .70 | .84 | .98 | 1.13 | 1.27 | |
| 4 | 1.33 | 1.67 | 2.00 | 2.33 | 2.67 | 3.00 | |
| 5 | 2.60 | 3.26 | 3.91 | 4.56 | 5.21 | 5.86 | |
| 6 | 4.50 | 5.63 | 6.75 | 7.88 | 9.00 | 10.13 | |
| 7 | 7.15 | 8.93 | 10.72 | 12.51 | 14.29 | 16.08 | |
| 8 | 10.67 | 13.33 | 16.00 | 18.67 | 21.33 | 24.00 | |
| 9 | 15.19 | 18.98 | 22.78 | 26.58 | 30.38 | 34.17 | |
| 10 | 20.83 | 26.04 | 31.25 | 36.46 | 41.67 | 46.87 | |
| 11 | 27.73 | 34.66 | 41.59 | 48.53 | 55.46 | 62.39 | |
| 12 | 36.00 | 45.00 | 54.00 | 63.00 | 72.00 | 81.00 | |
| 13 | 45.77 | 57.21 | 68.66 | 80.10 | 91.54 | 102.98 | 1 |
| 14 | 57.17 | 71.46 | 85.75 | 100.04 | 114.33 | 128.63 | 1 |
| 15 | 70.31 | 87.89 | 105.47 | 123.05 | 140.63 | 158.20 | 1 |
| 16 | 85.33 | 106.67 | 128.00 | 149.33 | 170.67 | 192.00 | 2 |
| 17 | 102.35 | 127.94 | 153.53 | 179.12 | 204.71 | 230.30 | 2 |
| 18 | 121.50 | 151.88 | 182.25 | 212.63 | 243.00 | 273.38 | 3 |
| 19 | 142.90 | 178.62 | 214.34 | 250.07 | 285.79 | 321.52 | 3 |
| 20 | 166.67 | 208.33 | 250.00 | 291.67 | 333.33 | 375.00 | 4 |
| 21 | 192.94 | 241.17 | 289.41 | 337.64 | 385.88 | 434.11 | 4 |
| 22 | 221.83 | 277.29 | 332.75 | 388.21 | 443.67 | 499.13 | 5 |
| 23 | 253.48 | 316.85 | 380.22 | 443.59 | 506.96 | 570.33 | 6 |
| 24 | 288.00 | 360.00 | 432.00 | 504.00 | 576.00 | 648.00 | 7 |
| 25 | 325.52 | 406.90 | 488.28 | 569.66 | 651.04 | 732.42 | 8 |
| 26 | 366.17 | 457.71 | 549.25 | 640.79 | 732.33 | 823.88 | 9 |
| 27 | 410.06 | 512.58 | 615.09 | 717.61 | 820.13 | 922.64 | 10 |
| 28 | 457.33 | 571.67 | 686.00 | 800.33 | 914.67 | 1029.00 | 11 |
| 29 | 508.10 | 635.13 | 762.16 | 889.18 | 1016.21 | 1143.23 | 12 |
| 30 | 562.50 | 703.13 | 843.75 | 984.38 | 1125.00 | 1265.63 | 14 |
| 32 | 682.67 | 853.33 | 1024.00 | 1194.67 | 1365.33 | 1536.00 | 17 |
| 34 | 818.83 | 1023.54 | 1228.25 | 1432.96 | 1637.67 | 1842.38 | 20 |
| 36 | 972.00 | 1215.00 | 1458.00 | 1701.00 | 1944.00 | 2187.00 | 24 |
| 38 | 1143.17 | 1428.96 | 1714.75 | 2000.54 | 2286.33 | 2572.13 | 28 |
| 40 | 1333.33 | 1666.67 | 2000.00 | 2333.33 | 2666.67 | 3000.00 | 33 |
| 42 | 1543.50 | 1929.38 | 2315.25 | 2701.13 | 3087.00 | 3472.88 | 38 |
| 44 | 1774.67 | 2218.33 | 2662.00 | 3105.67 | 3549.33 | 3993.00 | 44 |
| 46 | 2027.83 | 2534.79 | 3041.75 | 3548.71 | 4055.67 | 4562.63 | 50 |
| 48 | 2304.00 | 2880.00 | 3456.00 | 4032.00 | 4608.00 | 5184.00 | 57 |
| 50 | 2604.17 | 3255.21 | 3906.25 | 4557.29 | 5208.33 | 5859.38 | 65 |
| 52 | 2929.33 | 3661.67 | 4394.00 | 5126.33 | 5858.67 | 6591.00 | 73 |
| 54 | 3280.50 | 4100.63 | 4920.75 | 5740.88 | 6561.00 | 7381.13 | 82 |
| 56 | 3658.67 | 4573.33 | 5488.00 | 6402.67 | 7317.33 | 8232.00 | 91 |
| 58 | 4064.83 | 5081.04 | 6097.25 | 7113.46 | 8129.67 | 9145.87 | 101 |
| 60 | 4500.00 | 5625.00 | 6750.00 | 7875.00 | 9000.00 | 10125.00 | 112 |

## MOMENTS OF INERTIA OF ▮ RECTANGLES.

| Width of Rectangle in Inches. | | | | | | Depth in Inches. |
|---|---|---|---|---|---|---|
| 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 | |
| .46 | .50 | .54 | .58 | .63 | .67 | 2 |
| 1.55 | 1.69 | 1.83 | 1.97 | 2.11 | 2.25 | 3 |
| 3.67 | 4.00 | 4.33 | 4.67 | 5.00 | 5.33 | 4 |
| 7.16 | 7.81 | 8.46 | 9.11 | 9.77 | 10.42 | 5 |
| 12.38 | 13.50 | 14.63 | 15.75 | 16.88 | 18.00 | 6 |
| 19.65 | 21.44 | 23.22 | 25.01 | 26.80 | 28.58 | 7 |
| 29.33 | 32.00 | 34.67 | 37.33 | 40.00 | 42.67 | 8 |
| 41.77 | 45.56 | 49.36 | 53.16 | 56.95 | 60.75 | 9 |
| 57.29 | 62.50 | 67.71 | 72.92 | 78.13 | 83.33 | 10 |
| 76.26 | 83.19 | 90.12 | 97.05 | 103.98 | 110.92 | 11 |
| 99.00 | 108.00 | 117.00 | 126.00 | 135.00 | 144.00 | 12 |
| 125.87 | 137.31 | 148.75 | 160.20 | 171.64 | 183.08 | 13 |
| 157.21 | 171.50 | 185.79 | 200.08 | 214.38 | 228.67 | 14 |
| 193.36 | 210.94 | 228.52 | 246.09 | 263.67 | 281.25 | 15 |
| 234.67 | 256.00 | 277.33 | 298.67 | 320.00 | 341.33 | 16 |
| 281.47 | 307.06 | 332.65 | 358.24 | 383.83 | 409.42 | 17 |
| 334.13 | 364.50 | 394.88 | 425.25 | 455.63 | 486.00 | 18 |
| 392.96 | 428.69 | 464.41 | 500.14 | 535.86 | 571.58 | 19 |
| 458.33 | 500.00 | 541.67 | 583.33 | 625.00 | 666.67 | 20 |
| 530.58 | 578.81 | 627.05 | 675.28 | 723.52 | 771.75 | 21 |
| 610.04 | 665.50 | 720.96 | 776.42 | 831.87 | 887.33 | 22 |
| 697.07 | 760.44 | 823.81 | 887.18 | 950.55 | 1013.92 | 23 |
| 792.00 | 864.00 | 936.00 | 1008.00 | 1080.00 | 1152.00 | 24 |
| 895.18 | 976.56 | 1057.94 | 1139.32 | 1220.70 | 1302.08 | 25 |
| 1006.96 | 1098.50 | 1190.04 | 1281.58 | 1373.13 | 1464.67 | 26 |
| 1127.67 | 1230.19 | 1332.70 | 1435.22 | 1537.73 | 1640.25 | 27 |
| 1257.67 | 1372.00 | 1486.33 | 1600.67 | 1715.00 | 1829.33 | 28 |
| 1397.29 | 1524.31 | 1651.34 | 1778.36 | 1905.39 | 2032.42 | 29 |
| 1546.88 | 1687.50 | 1828.13 | 1968.75 | 2109.38 | 2250.00 | 30 |
| 1877.33 | 2048.00 | 2218.67 | 2389.33 | 2560.00 | 2730.67 | 32 |
| 2251.79 | 2456.50 | 2661.21 | 2865.92 | 3070.63 | 3275.33 | 34 |
| 2673.00 | 2916.00 | 3159.00 | 3402.00 | 3645.00 | 3888.00 | 36 |
| 3143.71 | 3429.50 | 3715.29 | 4001.08 | 4286.88 | 4572.67 | 38 |
| 3666.67 | 4000.00 | 4333.33 | 4666.67 | 5000.00 | 5333.33 | 40 |
| 4244.63 | 4630.50 | 5016.38 | 5402.25 | 5788.13 | 6174.00 | 42 |
| 4880.33 | 5324.00 | 5767.67 | 6211.33 | 6655.00 | 7098.67 | 44 |
| 5576.54 | 6083.50 | 6590.46 | 7097.42 | 7604.38 | 8111.33 | 46 |
| 6336.00 | 6912.00 | 7488.00 | 8064.00 | 8640.00 | 9216.00 | 48 |
| 7161.46 | 7812.50 | 8463.54 | 9114.58 | 9765.63 | 10416.67 | 50 |
| 8055.67 | 8788.00 | 9520.33 | 10252.67 | 10985.00 | 11717.33 | 52 |
| 9021.38 | 9841.50 | 10661.63 | 11481.75 | 12301.88 | 13122.00 | 54 |
| 10061.33 | 10976.00 | 11890.67 | 12805.33 | 13720.00 | 14634.67 | 56 |
| 11178.29 | 12194.50 | 13210.71 | 14226.92 | 15243.12 | 16259.33 | 58 |
| *12375.00* | *13500.00* | *14625.00* | 15750.00 | 16875.00 | 18000.00 | 60 |

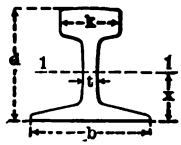
## MOMENTS OF INERTIA OF ▮ RECTANGLES.

| Depth in Inches. | Width of Rectangle in Inches. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 |
| 2 | .17 | .21 | .25 | .29 | .33 | .38 | .42 |
| 3 | .56 | .70 | .84 | .98 | 1.13 | 1.27 | 1.41 |
| 4 | 1.33 | 1.67 | 2.00 | 2.33 | 2.67 | 3.00 | 3.33 |
| 5 | 2.60 | 3.26 | 3.91 | 4.56 | 5.21 | 5.86 | 6.51 |
| 6 | 4.50 | 5.63 | 6.75 | 7.88 | 9.00 | 10.13 | 11.25 |
| 7 | 7.15 | 8.93 | 10.72 | 12.51 | 14.29 | 16.08 | 17.86 |
| 8 | 10.67 | 13.33 | 16.00 | 18.67 | 21.33 | 24.00 | 26.67 |
| 9 | 15.19 | 18.98 | 22.78 | 26.58 | 30.38 | 34.17 | 37.97 |
| 10 | 20.83 | 26.04 | 31.25 | 36.46 | 41.67 | 46.87 | 52.08 |
| 11 | 27.73 | 34.66 | 41.59 | 48.53 | 55.46 | 62.39 | 69.32 |
| 12 | 36.00 | 45.00 | 54.00 | 63.00 | 72.00 | 81.00 | 90.00 |
| 13 | 45.77 | 57.21 | 68.66 | 80.10 | 91.54 | 102.98 | 114.43 |
| 14 | 57.17 | 71.46 | 85.75 | 100.04 | 114.33 | 128.63 | 142.92 |
| 15 | 70.31 | 87.89 | 105.47 | 123.05 | 140.63 | 158.20 | 175.78 |
| 16 | 85.33 | 106.67 | 128.00 | 149.33 | 170.67 | 192.00 | 213.33 |
| 17 | 102.35 | 127.94 | 153.53 | 179.12 | 204.71 | 230.30 | 255.89 |
| 18 | 121.50 | 151.88 | 182.25 | 212.63 | 243.00 | 273.38 | 303.75 |
| 19 | 142.90 | 178.62 | 214.34 | 250.07 | 285.79 | 321.52 | 357.24 |
| 20 | 166.67 | 208.33 | 250.00 | 291.67 | 333.33 | 375.00 | 416.67 |
| 21 | 192.94 | 241.17 | 289.41 | 337.64 | 385.88 | 434.11 | 482.34 |
| 22 | 221.83 | 277.29 | 332.75 | 388.21 | 443.67 | 499.13 | 554.58 |
| 23 | 253.48 | 316.85 | 380.22 | 443.59 | 506.96 | 570.33 | 633.70 |
| 24 | 288.00 | 360.00 | 432.00 | 504.00 | 576.00 | 648.00 | 720.00 |
| 25 | 325.52 | 406.90 | 488.28 | 569.66 | 651.04 | 732.42 | 813.80 |
| 26 | 366.17 | 457.71 | 549.25 | 640.79 | 732.33 | 823.88 | 915.42 |
| 27 | 410.06 | 512.58 | 615.09 | 717.61 | 820.13 | 922.64 | 1025.16 |
| 28 | 457.33 | 571.67 | 686.00 | 800.33 | 914.67 | 1029.00 | 1143.33 |
| 29 | 508.10 | 635.13 | 762.16 | 889.18 | 1016.21 | 1143.23 | 1270.26 |
| 30 | 562.50 | 703.13 | 843.75 | 984.38 | 1125.00 | 1265.63 | 1406.25 |
| 32 | 682.67 | 853.33 | 1024.00 | 1194.67 | 1365.33 | 1536.00 | 1706.67 |
| 34 | 818.83 | 1023.54 | 1228.25 | 1432.96 | 1637.67 | 1842.88 | 2047.08 |
| 36 | 972.00 | 1215.00 | 1458.00 | 1701.00 | 1944.00 | 2187.00 | 2430.00 |
| 38 | 1143.17 | 1428.96 | 1714.75 | 2000.54 | 2286.33 | 2572.13 | 2857.92 |
| 40 | 1333.33 | 1666.67 | 2000.00 | 2333.33 | 2666.67 | 3000.00 | 3333.33 |
| 42 | 1543.50 | 1929.38 | 2315.25 | 2701.13 | 3087.00 | 3472.88 | 3858.75 |
| 44 | 1774.67 | 2218.33 | 2662.00 | 3105.67 | 3549.33 | 3993.00 | 4436.67 |
| 46 | 2027.83 | 2534.79 | 3041.75 | 3548.71 | 4055.67 | 4562.63 | 5069.58 |
| 48 | 2304.00 | 2880.00 | 3456.00 | 4032.00 | 4608.00 | 5184.00 | 5760.00 |
| 50 | 2604.17 | 3255.21 | 3906.25 | 4557.29 | 5208.33 | 5859.38 | 6510.42 |
| 52 | 2929.33 | 3661.67 | 4394.00 | 5126.33 | 5858.67 | 6591.00 | 7323.33 |
| 54 | 3280.50 | 4100.63 | 4920.75 | 5740.88 | 6561.00 | 7381.13 | 8201.25 |
| 56 | 3658.67 | 4573.33 | 5488.00 | 6402.67 | 7317.33 | 8232.00 | 9146.67 |
| 58 | 4064.83 | 5081.04 | 6097.25 | 7113.46 | 8129.67 | 9145.87 | 10162.08 |
| 60 | 4500.00 | 5625.00 | 6750.00 | 7875.00 | 9000.00 | 10125.00 | 11250.00 |

## MOMENTS OF INERTIA OF ▮ RECTANGLES.

| Width of Rectangle in Inches. | | | | | | Depth in Inches. |
|---|---|---|---|---|---|---|
| 1 1/16 | 3/4 | 1 3/16 | 7/8 | 1 5/16 | 1 | |
| .46 | .50 | .54 | .58 | .63 | .67 | 2 |
| 1.55 | 1.69 | 1.83 | 1.97 | 2.11 | 2.25 | 3 |
| 3.67 | 4.00 | 4.33 | 4.67 | 5.00 | 5.33 | 4 |
| 7.16 | 7.81 | 8.46 | 9.11 | 9.77 | 10.42 | 5 |
| 12.38 | 13.50 | 14.63 | 15.75 | 16.88 | 18.00 | 6 |
| 19.65 | 21.44 | 23.22 | 25.01 | 26.80 | 28.58 | 7 |
| 29.33 | 32.00 | 34.67 | 37.33 | 40.00 | 42.67 | 8 |
| 41.77 | 45.56 | 49.36 | 53.16 | 56.95 | 60.75 | 9 |
| 57.29 | 62.50 | 67.71 | 72.92 | 78.13 | 83.33 | 10 |
| 76.26 | 83.19 | 90.12 | 97.05 | 103.98 | 110.92 | 11 |
| 99.00 | 108.00 | 117.00 | 126.00 | 135.00 | 144.00 | 12 |
| 125.87 | 137.31 | 148.75 | 160.20 | 171.64 | 183.08 | 13 |
| 157.21 | 171.50 | 185.79 | 200.08 | 214.38 | 228.67 | 14 |
| 193.36 | 210.94 | 228.52 | 246.09 | 263.67 | 281.25 | 15 |
| 234.67 | 256.00 | 277.33 | 298.67 | 320.00 | 341.33 | 16 |
| 281.47 | 307.06 | 332.65 | 358.24 | 383.83 | 409.42 | 17 |
| 334.13 | 364.50 | 394.88 | 425.25 | 456.63 | 486.00 | 18 |
| 392.96 | 428.69 | 464.41 | 500.14 | 535.86 | 571.58 | 19 |
| 458.33 | 500.00 | 541.67 | 583.33 | 625.00 | 666.67 | 20 |
| 530.58 | 578.81 | 627.05 | 675.28 | 723.52 | 771.75 | 21 |
| 610.04 | 665.50 | 720.96 | 776.42 | 831.87 | 887.33 | 22 |
| 697.07 | 760.44 | 823.81 | 887.18 | 950.55 | 1013.92 | 23 |
| 792.00 | 864.00 | 936.00 | 1008.00 | 1080.00 | 1152.00 | 24 |
| 895.18 | 976.56 | 1057.94 | 1139.32 | 1220.70 | 1302.08 | 25 |
| 1006.96 | 1098.50 | 1190.04 | 1281.58 | 1373.13 | 1464.67 | 26 |
| 1127.67 | 1230.19 | 1332.70 | 1435.22 | 1537.73 | 1640.25 | 27 |
| 1257.67 | 1372.00 | 1486.33 | 1600.67 | 1715.00 | 1829.33 | 28 |
| 1397.29 | 1524.31 | 1651.34 | 1778.36 | 1905.39 | 2032.42 | 29 |
| 1546.88 | 1687.50 | 1828.13 | 1968.75 | 2109.38 | 2250.00 | 30 |
| 1877.33 | 2048.00 | 2218.67 | 2389.33 | 2560.00 | 2730.67 | 32 |
| 2251.79 | 2456.50 | 2661.21 | 2865.92 | 3070.63 | 3275.33 | 34 |
| 2673.00 | 2916.00 | 3159.00 | 3402.00 | 3645.00 | 3888.00 | 36 |
| 3143.71 | 3429.50 | 3715.29 | 4001.08 | 4286.88 | 4572.67 | 38 |
| 3666.67 | 4000.00 | 4333.33 | 4666.67 | 5000.00 | 5333.33 | 40 |
| 4244.63 | 4630.50 | 5016.38 | 5402.25 | 5788.13 | 6174.00 | 42 |
| 4880.33 | 5324.00 | 5767.67 | 6211.33 | 6655.00 | 7098.67 | 44 |
| 5576.54 | 6083.50 | 6590.46 | 7097.42 | 7604.38 | 8111.33 | 46 |
| 6336.00 | 6912.00 | 7488.00 | 8064.00 | 8640.00 | 9216.00 | 48 |
| 7161.46 | 7812.50 | 8463.54 | 9114.58 | 9765.63 | 10416.67 | 50 |
| 8055.67 | 8788.00 | 9520.33 | 10252.67 | 10985.00 | 11717.33 | 52 |
| 9021.38 | 9841.50 | 10661.63 | 11481.75 | 12301.88 | 13122.00 | 54 |
| 10061.33 | 10976.00 | 11890.67 | 12805.33 | 13720.00 | 14634.67 | 56 |
| 11178.29 | 12194.50 | 13210.71 | 14226.92 | 15243.12 | 16259.33 | 58 |
| *12375.00* | *18500.00* | *14625.00* | 15750.00 | 16875.00 | 18000.00 | 60 |

# PROPERTIES AND PRINCIPAL DIMENSIONS OF STANDARD T-RAILS.



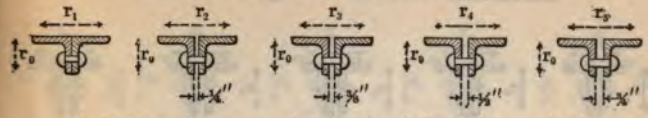

| No. of Section. | Weight per Yard. Pounds. | Area. Sq. Ins. | b Inches. | d Inches. | k Inches. | t Inches. | x Inches. | Axis 1-1. Moment of Inertia. I | Axis 1-1. Section Modulus. S |
|---|---|---|---|---|---|---|---|---|---|
| 522 | 8 | 0.78 | 1½ | 1½ | 13/16 | 5/32 | 0.75 | 0.23 | 0.31 |
| 523 | 12 | 1.18 | 1⅞ | 1⅞ | 1 1/16 | 3/16 | 0.92 | 0.55 | 0.58 |
| 524 | 16 | 1.57 | 2¼ | 2¼ | 1 3/16 | 7/32 | 1.10 | 1.13 | 0.99 |
| 525 | 20 | 2.0 | 2⅜ | 2⅜ | 1⅜ | ¼ | 1.2 | 1.5 | 1.2 |
| 526 | 25 | 2.5 | 2¾ | 2¾ | 1½ | 17/64 | 1.4 | 2.4 | 1.7 |
| 505 | 30 | 2.9 | 3 1/16 | 3 | 1 11/16 | 11/32 | 1.5 | 3.7 | 2.4 |
| 507 | 35 | 3.4 | 3⅜ | 3 1/16 | 1 27/32 | 19/32 | 1.5 | 4.3 | 2.8 |
| 508 | 40 | 3.9 | 3½ | 3½ | 1 27/32 | 23/64 | 1.7 | 6.0 | 3.4 |
| 501 | 45 | 4.4 | 3¾ | 3¾ | 1 59/64 | 5/8 | 1.8 | 7.6 | 3.9 |
| 542 | 50 | 4.9 | 3⅞ | 3⅞ | 2⅛ | 7/16 | 1.9 | 10.1 | 5.1 |
| 537 | 55 | 5.4 | 4 1/16 | 4 1/16 | 2¼ | 15/32 | 2.0 | 12.2 | 5.9 |
| 533 | 60 | 5.9 | 4¼ | 4¼ | 2⅜ | 31/64 | 2.1 | 14.7 | 6.7 |
| 534 | 65 | 6.4 | 4 7/16 | 4 1/16 | 2 13/32 | ½ | 2.1 | 17.0 | 7.4 |
| 532 | 70 | 6.9 | 4⅝ | 4⅝ | 2 7/16 | 33/64 | 2.2 | 20.0 | 8.4 |
| 529 | 75 | 7.4 | 4 13/16 | 4 13/16 | 2 15/32 | 17/32 | 2.3 | 23.0 | 9.1 |
| 530 | 80 | 7.8 | 5 | 5 | 2½ | 35/64 | 2.4 | 26.7 | 10.1 |
| 531 | 85 | 8.3 | 5 3/16 | 5 3/16 | 2 9/16 | 9/16 | 2.5 | 30.5 | 11.2 |
| 535 | 90 | 8.8 | 5⅜ | 5⅜ | 2⅝ | 9/16 | 2.6 | 35.2 | 12.6 |
| 536 | 100 | 9.8 | 5¾ | 5¾ | 2¾ | 9/16 | 2.8 | 44.4 | 15.0 |
| 539 | 150 | 14.7 | 6 | 6 | 4¼ | 1 | 3.0 | 69.3 | 22.9 |

Sections No. 529 to 537 inclusive and No. 542 are Am. Soc. C. E. Standard.

*For detail dimensions of Section No. 539 see page 20.*

# RADII OF GYRATION FOR TWO ANGLES PLACED BACK TO BACK.

## ANGLES WITH EQUAL LEGS.



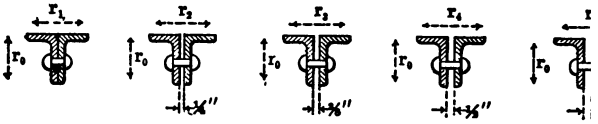

Radii of gyration correspond to directions indicated by arrowheads.

| Section Number. | Dimensions. Inches. | Thickness. Inches. | Area of Two Angles. Sq. Ins. | Radii of Gyration. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $r_0$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $r_5$ |
| A5 | 3/4 x 3/4 | 1/8 | 0.34 | 0.22 | 0.32 | 0.42 | 0.48 | 0.53 | 0.65 |
| " | " | 3/16 | 0.49 | 0.22 | 0.33 | 0.44 | 0.49 | 0.55 | 0.67 |
| A7 | 1 x 1 | 1/8 | 0.47 | 0.30 | 0.42 | 0.52 | 0.57 | 0.62 | 0.74 |
| " | " | 1/4 | 0.88 | 0.29 | 0.45 | 0.55 | 0.60 | 0.66 | 0.77 |
| A9 | 1 1/4 x 1 1/4 | 1/8 | 0.60 | 0.38 | 0.52 | 0.62 | 0.67 | 0.72 | 0.83 |
| " | " | 3/16 | 1.37 | 0.36 | 0.56 | 0.66 | 0.71 | 0.77 | 0.88 |
| A11 | 1 1/2 x 1 1/2 | 3/16 | 1.05 | 0.46 | 0.64 | 0.73 | 0.78 | 0.83 | 0.94 |
| " | " | 3/8 | 1.97 | 0.44 | 0.67 | 0.77 | 0.82 | 0.88 | 0.99 |
| A13 | 1 3/4 x 1 3/4 | 3/16 | 1.24 | 0.54 | 0.74 | 0.83 | 0.88 | 0.93 | 1.03 |
| " | " | 1/4 | 2.68 | 0.51 | 0.78 | 0.88 | 0.93 | 0.98 | 1.09 |
| A15 | 2 x 2 | 1/8 | 1.43 | 0.62 | 0.84 | 0.93 | 0.98 | 1.03 | 1.13 |
| " | " | 3/16 | 2.30 | 0.60 | 0.86 | 0.95 | 1.00 | 1.05 | 1.16 |
| " | " | 1/4 | 3.12 | 0.59 | 0.88 | 0.98 | 1.03 | 1.08 | 1.19 |
| *A41 | 2 1/4 x 2 1/4 | 3/16 | 1.62 | 0.70 | 0.94 | 1.03 | 1.08 | 1.12 | 1.22 |
| " | " | 1/4 | 3.09 | 0.67 | 0.97 | 1.06 | 1.11 | 1.16 | 1.27 |
| A17 | 2 1/2 x 2 1/2 | 1/4 | 2.38 | 0.77 | 1.05 | 1.14 | 1.19 | 1.24 | 1.34 |
| " | " | 5/16 | 3.47 | 0.75 | 1.07 | 1.16 | 1.21 | 1.26 | 1.36 |
| " | " | 1/2 | 4.50 | 0.74 | 1.09 | 1.19 | 1.24 | 1.29 | 1.39 |
| *A43 | 2 3/4 x 2 3/4 | 3/16 | 1.99 | 0.86 | 1.14 | 1.23 | 1.28 | 1.32 | 1.42 |
| " | " | 5/16 | 3.24 | 0.84 | 1.16 | 1.25 | 1.30 | 1.35 | 1.45 |
| " | " | 1/2 | 4.43 | 0.83 | 1.18 | 1.28 | 1.32 | 1.37 | 1.47 |
| A19 | 3 x 3 | 1/4 | 2.88 | 0.93 | 1.26 | 1.34 | 1.39 | 1.43 | 1.53 |
| " | " | 5/16 | 4.87 | 0.91 | 1.28 | 1.37 | 1.42 | 1.47 | 1.57 |
| " | " | 5/8 | 6.72 | 0.88 | 1.32 | 1.41 | 1.46 | 1.51 | 1.61 |
| A21 | 3 1/2 x 3 1/2 | 3/8 | 4.97 | 1.07 | 1.48 | 1.56 | 1.61 | 1.66 | 1.75 |
| " | " | 7/16 | 7.97 | 1.04 | 1.52 | 1.61 | 1.66 | 1.71 | 1.81 |
| " | " | 11/16 | 10.05 | 1.02 | 1.55 | 1.65 | 1.70 | 1.75 | 1.85 |
| A23 | 4 x 4 | 5/16 | 4.80 | 1.24 | 1.67 | 1.76 | 1.80 | 1.85 | 1.94 |
| " | " | 7/16 | 8.37 | 1.21 | 1.71 | 1.80 | 1.85 | 1.89 | 1.99 |
| " | " | 13/16 | 11.68 | 1.18 | 1.75 | 1.85 | 1.89 | 1.94 | 2.04 |
| *A45 | 4 1/2 x 4 1/2 | 5/16 | 5.43 | 1.40 | 1.87 | 1.96 | 2.00 | 2.05 | 2.14 |
| " | " | 1/2 | 8.50 | 1.38 | 1.90 | 1.99 | 2.04 | 2.08 | 2.18 |
| " | " | 5/8 | 10.47 | 1.36 | 1.92 | 2.01 | 2.06 | 2.10 | 2.20 |
| *A47 | 5 x 5 | 3/8 | 7.22 | 1.56 | 2.09 | 2.17 | 2.22 | 2.26 | 2.35 |
| " | " | 1/2 | 9.50 | 1.54 | 2.10 | 2.19 | 2.24 | 2.28 | 2.38 |
| " | " | 5/8 | 11.72 | 1.52 | 2.12 | 2.21 | 2.26 | 2.30 | 2.40 |
| A27 | 6 x 6 | 7/16 | 10.12 | 1.87 | 2.50 | 2.58 | 2.63 | 2.67 | 2.76 |
| " | " | 5/8 | 14.22 | 1.84 | 2.53 | 2.62 | 2.66 | 2.71 | 2.80 |
| " | " | 7/8 | 19.47 | 1.81 | 2.57 | 2.66 | 2.70 | 2.75 | 2.85 |

*Angles marked * are special sections.*

# RADII OF GYRATION FOR TWO ANGLES PLACED BACK TO BACK.

## ANGLES WITH UNEQUAL LEGS.




Radii of gyration correspond to directions indicated by arrowheads.

| Section Number. | Dimensions. Inches. | Thickness. Inches. | Area of Two Angles. Sq. Ins. | Radii of Gyration. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $r_0$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | |
| *A121 | 2 x 1⅜ | ⅜ | 1.20 | 0.63 | 0.54 | 0.62 | 0.67 | 0.72 | 0 |
| " | " | ⅝ | 2.25 | 0.61 | 0.56 | 0.66 | 0.71 | 0.76 | 0 |
| *A123 | 2 x 1½ | ⅜ | 1.24 | 0.63 | 0.59 | 0.68 | 0.73 | 0.78 | 0 |
| " | " | ⅝ | 2.34 | 0.61 | 0.62 | 0.72 | 0.77 | 0.82 | 0 |
| *A125 | 2½ x 1¼ | ⅜ | 1.34 | 0.80 | 0.44 | 0.52 | 0.58 | 0.63 | 0 |
| " | " | ⅝ | 2.53 | 0.78 | 0.47 | 0.57 | 0.62 | 0.68 | 0 |
| *A127 | 2½ x 1½ | ⅜ | 1.43 | 0.80 | 0.55 | 0.64 | 0.69 | 0.74 | 0 |
| " | " | ⅝ | 2.72 | 0.78 | 0.58 | 0.68 | 0.73 | 0.78 | 0 |
| *A161 | 2½ x 1¾ | ⅜ | 1.52 | 0.80 | 0.67 | 0.75 | 0.80 | 0.85 | 0 |
| " | " | ¼ | 2.00 | 0.79 | 0.68 | 0.77 | 0.81 | 0.86 | 0 |
| A91 | 2½ x 2 | ⅜ | 1.62 | 0.79 | 0.79 | 0.88 | 0.92 | 0.97 | 1 |
| " | " | ⅝ | 3.09 | 0.77 | 0.82 | 0.91 | 0.96 | 1.01 | 1 |
| " | " | ½ | 4.00 | 0.75 | 0.84 | 0.94 | 0.99 | 1.04 | 1 |
| *A128 | 2¾ x 1½ | ⅜ | 1.52 | 0.89 | 0.53 | 0.62 | 0.67 | 0.72 | 0 |
| " | " | ½ | 2.46 | 0.87 | 0.55 | 0.65 | 0.70 | 0.75 | 0 |
| " | " | ⅝ | 3.34 | 0.85 | 0.58 | 0.68 | 0.73 | 0.78 | 0 |
| *A129 | 3 x 2 | ⅜ | 1.80 | 0.97 | 0.75 | 0.83 | 0.88 | 0.93 | 1 |
| " | " | ½ | 2.93 | 0.95 | 0.76 | 0.85 | 0.90 | 0.95 | 1 |
| " | " | ⅝ | 3.99 | 0.93 | 0.79 | 0.88 | 0.93 | 0.98 | 1 |
| A93 | 3 x 2½ | ¼ | 2.63 | 0.95 | 1.00 | 1.09 | 1.13 | 1.18 | 1 |
| " | " | ½ | 3.84 | 0.93 | 1.02 | 1.11 | 1.16 | 1.21 | 1 |
| " | " | ⅝ | 5.55 | 0.91 | 1.05 | 1.15 | 1.20 | 1.25 | 1 |
| A95 | 3½ x 2½ | ¼ | 2.88 | 1.12 | 0.96 | 1.04 | 1.09 | 1.13 | 1 |
| " | " | ½ | 5.50 | 1.09 | 1.00 | 1.09 | 1.14 | 1.19 | 1 |
| " | " | ⅝ | 7.30 | 1.06 | 1.03 | 1.13 | 1.18 | 1.23 | 1 |
| A97 | 3½ x 3 | ⅜ | 3.87 | 1.10 | 1.21 | 1.30 | 1.35 | 1.39 | 1 |
| " | " | ½ | 6.68 | 1.07 | 1.25 | 1.34 | 1.39 | 1.44 | 1 |
| " | " | ⅝ | 9.24 | 1.04 | 1.30 | 1.40 | 1.45 | 1.50 | 1 |

Angles marked * are special sections.

# RADII OF GYRATION FOR TWO ANGLES PLACED BACK TO BACK.

## ANGLES WITH UNEQUAL LEGS.

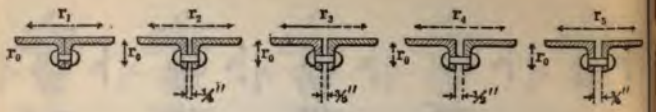
Radii of gyration correspond to directions indicated by arrowheads.

| Section Number. | Dimensions. Inches. | Thickness. Inches. | Area of Two Angles. Sq. Ins. | Radii of Gyration. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $r_0$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $r_5$ |
| A99 | 4 x 3 | 5/16 | 4.18 | 1.27 | 1.17 | 1.25 | 1.30 | 1.34 | 1.44 |
| " | " | 7/16 | 7.24 | 1.24 | 1.21 | 1.30 | 1.34 | 1.39 | 1.49 |
| " | " | 1/2 | 10.05 | 1.21 | 1.25 | 1.35 | 1.40 | 1.45 | 1.55 |
| *A131 | 4 x 3½ | 5/16 | 4.49 | 1.26 | 1.42 | 1.50 | 1.55 | 1.59 | 1.69 |
| " | " | 7/16 | 7.00 | 1.23 | 1.44 | 1.53 | 1.58 | 1.63 | 1.72 |
| " | " | 1/2 | 8.59 | 1.22 | 1.46 | 1.55 | 1.60 | 1.65 | 1.75 |
| *A133 | 4½ x 3 | 3/8 | 5.34 | 1.44 | 1.14 | 1.22 | 1.27 | 1.31 | 1.41 |
| " | " | 7/16 | 7.00 | 1.42 | 1.15 | 1.24 | 1.29 | 1.34 | 1.44 |
| " | " | 1/2 | 8.59 | 1.40 | 1.18 | 1.27 | 1.31 | 1.36 | 1.46 |
| A101 | 5 x 3 | 5/16 | 4.80 | 1.61 | 1.09 | 1.17 | 1.22 | 1.26 | 1.36 |
| " | " | 7/16 | 8.37 | 1.58 | 1.13 | 1.22 | 1.26 | 1.31 | 1.41 |
| " | " | 1/2 | 11.68 | 1.55 | 1.17 | 1.27 | 1.32 | 1.37 | 1.47 |
| A103 | 5 x 3½ | 3/8 | 6.09 | 1.60 | 1.34 | 1.42 | 1.46 | 1.51 | 1.60 |
| " | " | 7/16 | 9.84 | 1.56 | 1.37 | 1.46 | 1.51 | 1.56 | 1.66 |
| " | " | 1/2 | 13.34 | 1.53 | 1.42 | 1.51 | 1.56 | 1.61 | 1.71 |
| *A135 | 5 x 4 | 3/8 | 6.47 | 1.59 | 1.58 | 1.66 | 1.71 | 1.75 | 1.85 |
| " | " | 7/16 | 8.50 | 1.57 | 1.60 | 1.68 | 1.73 | 1.78 | 1.87 |
| " | " | 1/2 | 10.47 | 1.55 | 1.62 | 1.71 | 1.75 | 1.80 | 1.90 |
| A105 | 6 x 3½ | 3/8 | 6.84 | 1.94 | 1.26 | 1.34 | 1.39 | 1.43 | 1.53 |
| " | " | 7/16 | 11.09 | 1.90 | 1.30 | 1.39 | 1.43 | 1.48 | 1.58 |
| " | " | 1/2 | 15.09 | 1.87 | 1.34 | 1.44 | 1.49 | 1.53 | 1.64 |
| A107 | 6 x 4 | 3/8 | 7.22 | 1.93 | 1.50 | 1.58 | 1.62 | 1.67 | 1.76 |
| " | " | 7/16 | 11.72 | 1.90 | 1.53 | 1.62 | 1.67 | 1.71 | 1.81 |
| " | " | 1/2 | 15.97 | 1.86 | 1.58 | 1.67 | 1.71 | 1.76 | 1.86 |
| *A109 | 7 x 3½ | 5/16 | 8.80 | 2.26 | 1.16 | 1.29 | 1.33 | 1.38 | 1.47 |
| " | " | 7/16 | 10.00 | 2.25 | 1.22 | 1.30 | 1.35 | 1.39 | 1.48 |
| " | " | 1/2 | 12.34 | 2.24 | 1.24 | 1.32 | 1.37 | 1.42 | 1.51 |
| " | " | 9/16 | 15.74 | 2.21 | 1.27 | 1.36 | 1.41 | 1.46 | 1.56 |
| " | " | 1 | 19.00 | 2.19 | 1.31 | 1.40 | 1.45 | 1.50 | 1.60 |

*Angles marked* * *are special sections.*

# RADII OF GYRATION FOR TWO ANGLES PLACED BACK TO BACK.

## ANGLES WITH UNEQUAL LEGS.



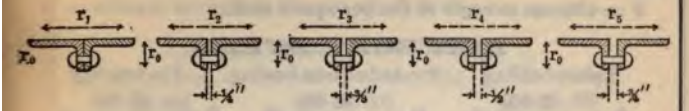

Radii of gyration correspond to directions indicated by arrowheads.

| Section Number. | Dimensions. Inches. | Thickness. Inches. | Area of Two Angles. Sq. Ins. | Radii of Gyration. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $r_0$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $r_5$ |
| *A121 | 2 x 1⅜ | ⅜ | 1.20 | 0.41 | 0.92 | 1.01 | 1.06 | 1.11 | 1.22 |
| " | " | ½ | 2.25 | 0.38 | 0.95 | 1.05 | 1.10 | 1.15 | 1.26 |
| *A123 | 2 x 1½ | ⅜ | 1.24 | 0.44 | 0.90 | 0.99 | 1.05 | 1.09 | 1.20 |
| " | " | ½ | 2.34 | 0.42 | 0.93 | 1.09 | 1.14 | 1.19 | 1.29 |
| *A125 | 2½ x 1¼ | ⅜ | 1.34 | 0.33 | 1.21 | 1.31 | 1.36 | 1.41 | 1.51 |
| " | " | ½ | 2.53 | 0.32 | 1.25 | 1.35 | 1.40 | 1.45 | 1.56 |
| *A127 | 2½ x 1½ | ⅜ | 1.43 | 0.42 | 1.17 | 1.26 | 1.31 | 1.36 | 1.47 |
| " | " | ½ | 2.72 | 0.40 | 1.20 | 1.30 | 1.35 | 1.40 | 1.51 |
| *A161 | 2½ x 1¾ | ⅜ | 1.52 | 0.51 | 1.13 | 1.23 | 1.27 | 1.32 | 1.43 |
| " | " | ¼ | 2.00 | 0.50 | 1.14 | 1.24 | 1.29 | 1.34 | 1.44 |
| A91 | 2½ x 2 | ⅜ | 1.62 | 0.60 | 1.10 | 1.19 | 1.24 | 1.29 | 1.39 |
| " | " | ⅝ | 3.09 | 0.58 | 1.13 | 1.23 | 1.28 | 1.33 | 1.43 |
| " | " | ½ | 4.00 | 0.56 | 1.15 | 1.25 | 1.30 | 1.35 | 1.46 |
| *A128 | 2¾ x 1½ | ⅜ | 1.52 | 0.41 | 1.31 | 1.40 | 1.45 | 1.50 | 1.60 |
| " | " | ½ | 2.46 | 0.40 | 1.33 | 1.43 | 1.48 | 1.53 | 1.63 |
| " | " | 7/16 | 3.34 | 0.39 | 1.36 | 1.45 | 1.51 | 1.56 | 1.66 |
| *A129 | 3 x 2 | ⅜ | 1.80 | 0.58 | 1.37 | 1.46 | 1.51 | 1.56 | 1.66 |
| " | " | ½ | 2.93 | 0.57 | 1.39 | 1.48 | 1.53 | 1.58 | 1.68 |
| " | " | 9/16 | 3.99 | 0.55 | 1.41 | 1.51 | 1.56 | 1.61 | 1.71 |
| A93 | 3 x 2½ | ¼ | 2.63 | 0.75 | 1.31 | 1.40 | 1.45 | 1.50 | 1.60 |
| " | " | ½ | 3.84 | 0.74 | 1.33 | 1.42 | 1.47 | 1.52 | 1.63 |
| " | " | ⅝ | 5.55 | 0.72 | 1.37 | 1.46 | 1.51 | 1.56 | 1.66 |
| A95 | 3½ x 2½ | ¼ | 2.88 | 0.74 | 1.58 | 1.67 | 1.72 | 1.76 | 1.86 |
| " | " | ½ | 5.50 | 0.70 | 1.62 | 1.72 | 1.77 | 1.81 | 1.92 |
| " | " | 11/16 | 7.30 | 0.69 | 1.66 | 1.75 | 1.80 | 1.86 | 1 96 |
| A97 | 3½ x 3 | ¼ | 3.87 | 0.90 | 1.52 | 1.61 | 1.66 | 1.71 | 1.80 |
| " | " | ½ | 6.68 | 0.87 | 1.57 | 1.66 | 1.71 | 1.76 | 1.86 |
| " | " | 11/16 | 9.24 | 0.85 | 1.61 | 1.71 | 1.76 | 1.81 | 1.91 |

Angles marked * are special sections.

# RADII OF GYRATION FOR TWO ANGLES PLACED BACK TO BACK.

## ANGLES WITH UNEQUAL LEGS.




Radii of gyration correspond to directions indicated by arrowheads.

| Section Number. | Dimensions. Inches. | Thickness. Inches. | Area of Two Angles, Sq. Ins. | Radii of Gyration. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | $r_0$ | $r_1$ | $r_2$ | $r_3$ | $r_4$ | $r_5$ |
| A99 | 4 x 3 | 5/16 | 4.18 | 0.89 | 1.79 | 1.88 | 1.93 | 1.97 | 2.07 |
| " | " | 7/16 | 7.24 | 0.86 | 1.83 | 1.93 | 1.97 | 2.02 | 2.12 |
| " | " | 13/16 | 10.05 | 0.83 | 1.88 | 1.97 | 2.02 | 2.08 | 2.18 |
| *A131 | 4 x 3½ | 5/16 | 4.49 | 1.07 | 1.73 | 1.81 | 1.86 | 1.91 | 2.00 |
| " | " | 7/16 | 7.00 | 1.04 | 1.76 | 1.85 | 1.89 | 1.94 | 2.04 |
| " | " | 5/8 | 8.59 | 1.02 | 1.78 | 1.87 | 1.92 | 1.97 | 2.07 |
| *A133 | 4½ x 3 | 3/8 | 5.34 | 0.86 | 2.07 | 2.16 | 2.21 | 2.26 | 2.35 |
| " | " | 7/16 | 7.00 | 0.85 | 2.09 | 2.18 | 2.23 | 2.28 | 2.38 |
| " | " | 5/8 | 8.59 | 0.83 | 2.11 | 2.21 | 2.26 | 2.31 | 2.41 |
| A101 | 5 x 3 | 5/16 | 4.80 | 0.85 | 2.33 | 2.42 | 2.47 | 2.52 | 2.61 |
| " | " | 7/16 | 8.37 | 0.82 | 2.37 | 2.47 | 2.52 | 2.57 | 2.67 |
| " | " | 13/16 | 11.68 | 0.80 | 2.42 | 2.52 | 2.57 | 2.62 | 2.72 |
| A103 | 5 x 3½ | 3/8 | 6.09 | 1.02 | 2.27 | 2.36 | 2.41 | 2.45 | 2.55 |
| " | " | 7/16 | 9.84 | 0.99 | 2.31 | 2.40 | 2.45 | 2.50 | 2.60 |
| " | " | 5/8 | 13.34 | 0.96 | 2.36 | 2.45 | 2.50 | 2.55 | 2.65 |
| *A135 | 5 x 4 | 3/8 | 6.47 | 1.20 | 2.20 | 2.29 | 2.34 | 2.38 | 2.48 |
| " | " | 1/2 | 8.50 | 1.18 | 2.22 | 2.31 | 2.36 | 2.41 | 2.50 |
| " | " | 5/8 | 10.47 | 1.17 | 2.24 | 2.33 | 2.38 | 2.43 | 2.53 |
| A105 | 6 x 3½ | 3/8 | 6.84 | 0.99 | 2.81 | 2.90 | 2.95 | 3.00 | 3.09 |
| " | " | 5/8 | 11.09 | 0.96 | 2.86 | 2.95 | 3.00 | 3.05 | 3.15 |
| " | " | 7/8 | 15.09 | 0.93 | 2.90 | 3.00 | 3.05 | 3.10 | 3.20 |
| A107 | 6 x 4 | 3/8 | 7.22 | 1.17 | 2.74 | 2.83 | 2.87 | 2.92 | 3.02 |
| " | " | 5/8 | 11.72 | 1.13 | 2.78 | 2.87 | 2.92 | 2.97 | 3.06 |
| " | " | 7/8 | 15.97 | 1.11 | 2.82 | 2.92 | 2.97 | 3.02 | 3.12 |
| *A109 | 7 x 3½ | 7/16 | 8.80 | 0.95 | 3.37 | 3.47 | 3.52 | 3.56 | 3.66 |
| " | " | 5/8 | 10.00 | 0.94 | 3.39 | 3.48 | 3.53 | 3.58 | 3.67 |
| " | " | 7/8 | 12.34 | 0.93 | 3.40 | 3.50 | 3.55 | 3.60 | 3.70 |
| " | " | 1 1/8 | 15.64 | 0.91 | 3.45 | 3.54 | 3.59 | 3.64 | 3.74 |
| " | " | 1 | 19.00 | 0.89 | 3.48 | 3.58 | 3.63 | 3.68 | 3.78 |

*Angles marked* * are special sections.

## STRENGTH OF STEEL COLUMNS OR STRUTS.

For various values of $\frac{L}{r}$ in which L = length in feet and r = radius of gyration in inches.

P = ultimate strength in lbs. per square inch.

### FOR SOFT STEEL.

Square bearing $P = \frac{45\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$

Pin and square bearing $P = \frac{45\,000}{1+\frac{(12\,L)^2}{24\,000\,r^2}}$

Pin bearing $P = \frac{45\,000}{1+\frac{(12\,L)^2}{18\,000\,r^2}}$

To obtain safe unit stress:

For quiescent loads, as in buildings, divide by 4.
For moving loads, as in bridges, divide by 5.

| $\frac{L}{r}$ | Ultimate Strength in lbs per Square Inch. | | | $\frac{L}{r}$ | Ultimate Strength in lbs. per Square Inch. | | |
|---|---|---|---|---|---|---|---|
| | Square. | Pin and Square. | Pin. | | Square. | Pin and Square. | Pin. |
| 3.0 | 43437 | 42694 | 41978 | 7.6 | 36554 | 33419 | 30779 |
| 3.2 | 43230 | 42395 | 41593 | 7.8 | 36193 | 32966 | 30268 |
| 3.4 | 43011 | 42081 | 41190 | | | | |
| 3.6 | 42782 | 41754 | 40773 | 8.0 | 35828 | 32514 | 29762 |
| 3.8 | 42543 | 41412 | 40340 | 8.2 | 35462 | 32064 | 29260 |
| | | | | 8.4 | 35095 | 31615 | 28763 |
| 4.0 | 42294 | 41058 | 39893 | 8.6 | 34727 | 31169 | 28272 |
| 4.2 | 42035 | 40693 | 39435 | 8.8 | 34358 | 30724 | 27787 |
| 4.4 | 41765 | 40317 | 38966 | | | | |
| 4.6 | 41488 | 39930 | 38485 | 9.0 | 33988 | 30282 | 27306 |
| 4.8 | 41203 | 39534 | 37998 | 9.2 | 33611 | 29844 | 26832 |
| | | | | 9.4 | 33249 | 29408 | 26364 |
| 5.0 | 40910 | 39130 | 37500 | 9.6 | 32880 | 28977 | 25903 |
| 5.2 | 40608 | 38807 | 36997 | 9.8 | 32511 | 28549 | 25448 |
| 5.4 | 40299 | 38300 | 36488 | | | | |
| 5.6 | 39984 | 37874 | 35975 | 10.0 | 32143 | 28125 | 25000 |
| 5.8 | 39663 | 37443 | 35457 | 10.2 | 31776 | 27706 | 24559 |
| | | | | 10.4 | 31411 | 27290 | 24125 |
| 6.0 | 39335 | 37006 | 34938 | 10.6 | 31054 | 26879 | 23698 |
| 6.2 | 39003 | 36566 | 34416 | 10.8 | 30684 | 26474 | 23279 |
| 6.4 | 38665 | 36122 | 33894 | | | | |
| 6.6 | 38323 | 35676 | 33371 | 11.0 | 30324 | 26072 | 22866 |
| 6.8 | 37976 | 35219 | 32849 | 11.2 | 29965 | 25675 | 22460 |
| | | | | 11.4 | 29608 | 25285 | 22063 |
| 7.0 | 37616 | 34776 | 32328 | 11.6 | 29247 | 24899 | 21671 |
| 7.2 | 37272 | 34324 | 31809 | 11.8 | 28903 | 24517 | 21288 |
| 7.4 | 36914 | 33872 | 31292 | | | | |

## RENGTH OF STEEL COLUMNS OR STRUTS.

various values of $\frac{L}{r}$ in which L = length in feet and r = radius
ation in inches.
= ultimate strength in lbs. per square inch.

### FOR SOFT STEEL.

Square bearing $= \frac{45\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$ Pin and square bearing $P = \frac{45\,000}{1+\frac{(12\,L)^2}{24\,000\,r^2}}$ Pin bearing $P = \frac{45\,000}{1+\frac{(12\,L)^2}{18\,000\,r^2}}$

obtain safe unit stress:

For quiescent loads, as in buildings, divide by 4.
For moving loads, as in bridges, divide by 5.

| Ultimate Strength in lbs. per Square Inch. | | | $\frac{L}{r}$ | Ultimate Strength in lbs. per Square Inch. | | |
|---|---|---|---|---|---|---|
| Square. | Pin and Square. | Pin. | | Square. | Pin and Square. | Pin. |
| 28553 | 24142 | 20911 | 16.6 | 21406 | 16960 | 14043 |
| 28207 | 23771 | 20542 | 16.8 | 21137 | 16708 | 13812 |
| 27863 | 23406 | 20179 | | | | |
| 27522 | 23046 | 19823 | 17.0 | 20872 | 16459 | 13584 |
| 27185 | 22693 | 19474 | 17.2 | 20611 | 16216 | 13366 |
| | | | 17.4 | 20353 | 15977 | 13150 |
| 26850 | 22343 | 19133 | 17.6 | 20098 | 15742 | 12938 |
| 26524 | 22005 | 18797 | 17.8 | 19847 | 15512 | 12731 |
| 26189 | 21662 | 18469 | | | | |
| 25864 | 21329 | 18148 | 18.0 | 19599 | 15286 | 12528 |
| 25543 | 21002 | 17833 | 18.2 | 19351 | 15063 | 12329 |
| | | | 18.4 | 19114 | 14845 | 12135 |
| 25224 | 20680 | 17523 | 18.6 | 18878 | 14630 | 11944 |
| 24909 | 20363 | 17221 | 18.8 | 18644 | 14420 | 11757 |
| 24598 | 20052 | 16925 | | | | |
| 24290 | 19746 | 16634 | 19.0 | 18418 | 14218 | 11579 |
| 23985 | 19445 | 16350 | 19.2 | 18185 | 14010 | 11394 |
| | | | 19.4 | 17961 | 13811 | 11219 |
| 23684 | 19148 | 16071 | 19.6 | 17740 | 13616 | 11048 |
| 23387 | 18858 | 15799 | 19.8 | 17519 | 13422 | 10877 |
| 23093 | 18572 | 15532 | | | | |
| 22803 | 18288 | 15270 | 20.0 | 17308 | 13235 | 10715 |
| 22516 | 18015 | 15105 | 20.2 | 17096 | 13050 | 10553 |
| | | | 20.4 | 16888 | 12868 | 10434 |
| 22234 | 17744 | 14764 | 20.6 | 16682 | 12690 | 10249 |
| 21954 | 17478 | 14518 | 20.8 | 16480 | 12515 | 10087 |
| *21678* | *17216* | *14279* | | | | |

## STRENGTH OF STEEL COLUMNS OR STRUTS.

For various values of $\frac{L}{r}$ in which L = length in feet and r = radius of gyration in inches.

P = Ultimate strength in lbs. per square inch.

### FOR MEDIUM STEEL.

| Square bearing | Flat and square bearing | Pin bearing |
|---|---|---|
| $P = \frac{60\,000}{1 + \frac{L^2}{r^2} \div 6\,000}$ | $P = \frac{60\,000}{1 + \frac{L^2}{r^2} \div 24\,000}$ | $P = \frac{60\,000}{1 + \frac{L^2}{r^2} \div 48\,000}$ |

To obtain safe unit stress:

For dead stress, as in buildings, divide by 4.
For moving loads, as in bridges, divide by 6.

| $\frac{L}{r}$ | Ultimate Strength in lbs. per Square Inch. Square. | Flat and Square. | Pin. | $\frac{L}{r}$ | Ultimate Strength in lbs. per Square Inch. Square. | Flat and Square. | Pin. |
|---|---|---|---|---|---|---|---|
| ... | .8253 | .7438 | .6642 | 7.3 | .40616 | .37132 | .34198 |
| ... | .8033 | .7196 | .6214 | 7.8 | .40214 | .36629 | .33881 |
| ... | .7790 | .6777 | .5767 | | | | |
| ... | .7736 | .6393 | .5303 | 8.0 | .39809 | .36127 | .33068 |
| ... | .7570 | .6013 | .4822 | .2 | .39402 | .35627 | .32511 |
| | | | | .4 | .38994 | .35128 | .31959 |
| ... | .6998 | .5620 | .4325 | .6 | .38585 | .34632 | .31413 |
| ... | .6705 | .5214 | .3817 | .8 | .38175 | .34138 | .30874 |
| ... | .6406 | .4797 | .3296 | | | | |
| ... | .6098 | .4367 | .2761 | 9.0 | .37764 | .33647 | .30340 |
| ... | .5781 | .3927 | .2220 | .2 | .37345 | .33160 | .29813 |
| | | | | .4 | .36943 | .32676 | .29293 |
| ... | .5455 | .3473 | .1667 | .6 | .36538 | .32197 | .28781 |
| ... | .5120 | .3119 | .1108 | .8 | .36123 | .31721 | .28275 |
| ... | .4777 | .2555 | .0542 | | | | |
| | .4427 | .2082 | .9972 | 10.0 | .35714 | .31250 | .27778 |
| ... | .4079 | .1703 | .9397 | .2 | .35307 | .30784 | .27288 |
| | | | | .4 | .34901 | .30322 | .26806 |
| | .3726 | .1315 | .8820 | .6 | .34504 | .29866 | .26331 |
| ... | .3367 | .0929 | .8240 | .8 | .34098 | .29415 | .25865 |
| ... | .2961 | .0536 | .7660 | | | | |
| ... | .2561 | .0140 | .7079 | 11.0 | .33698 | .28969 | .25407 |
| ... | .2156 | .9742 | .6499 | .2 | .33294 | .28525 | .24956 |
| | | | | .4 | .32898 | .28094 | .24514 |
| ... | .1750 | .9340 | .5920 | .6 | .32497 | .27665 | .24079 |
| ... | .1343 | .8938 | .5343 | .8 | .32114 | .27241 | .23653 |
| ... | .0936 | .8535 | .4769 | | | | |

## STRENGTH OF STEEL COLUMNS OR STRUTS.

For various values of $\frac{L}{r}$ in which L = length in feet and r = radius of gyration in inches.

P = ultimate strength in lbs. per square inch.

### FOR MEDIUM STEEL.

Square bearing $P = \frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$

Pin and Square bearing $P = \frac{50\,000}{1+\frac{(12\,L)^2}{24\,000\,r^2}}$

Pin bearing $P = \frac{50\,000}{1+\frac{(12\,L)^2}{18\,000\,r^2}}$

To obtain safe unit stress:

For quiescent loads, as in buildings, divide by 4.
For moving loads, as in bridges, divide by 5.

| $\frac{L}{r}$ | Ultimate Strength in lbs. per Square Inch. | | | $\frac{L}{r}$ | Ultimate Strength in lbs. per Square Inch. | | |
|---|---|---|---|---|---|---|---|
| | Square. | Pin and Square. | Pin. | | Square. | Pin and Square. | Pin. |
| 12.0 | 31726 | 26824 | 23234 | 16.6 | 23784 | 18844 | 15603 |
| 12.2 | 31341 | 26412 | 22824 | 16.8 | 23486 | 18564 | 15347 |
| 12.4 | 30959 | 26007 | 22421 | | | | |
| 12.6 | 30580 | 25607 | 22026 | 17.0 | 23191 | 18288 | 15093 |
| 12.8 | 30205 | 25214 | 21638 | 17.2 | 22901 | 18018 | 14851 |
| | | | | 17.4 | 22614 | 17752 | 14611 |
| 13.0 | 29833 | 24826 | 21259 | 17.6 | 22331 | 17491 | 14376 |
| 13.2 | 29471 | 24450 | 20886 | 17.8 | 22052 | 17235 | 14145 |
| 13.4 | 29099 | 24069 | 20521 | | | | |
| 13.6 | 28738 | 23699 | 20164 | 18.0 | 21777 | 16984 | 13920 |
| 13.8 | 28381 | 23336 | 19814 | 18.2 | 21501 | 16737 | 13699 |
| | | | | 18.4 | 21238 | 16494 | 13483 |
| 14.0 | 28027 | 22978 | 19470 | 18.6 | 20975 | 16256 | 13271 |
| 14.2 | 27677 | 22626 | 19134 | 18.8 | 20715 | 16022 | 13063 |
| 14.4 | 27331 | 22280 | 18805 | | | | |
| 14.6 | 26989 | 21940 | 18482 | 19.0 | 20464 | 15798 | 12865 |
| 14.8 | 26650 | 21605 | 18167 | 19.2 | 20206 | 15567 | 12661 |
| | | | | 19.4 | 19957 | 15346 | 12466 |
| 15.0 | 26316 | 21276 | 17857 | 19.6 | 19711 | 15129 | 12275 |
| 15.2 | 25985 | 20953 | 17554 | 19.8 | 19466 | 14913 | 12086 |
| 15.4 | 25659 | 20636 | 17258 | | | | |
| 15.6 | 25337 | 20320 | 16967 | 20.0 | 19231 | 14706 | 11905 |
| 15.8 | 25018 | 20017 | 16683 | 20.2 | 18996 | 14500 | 11725 |
| | | | | 20.4 | 18764 | 14298 | 11549 |
| 16.0 | 24704 | 19716 | 16404 | 20.6 | 18536 | 14100 | 11377 |
| 16.2 | 24393 | 19420 | 16131 | 20.8 | 18311 | 13905 | 11208 |
| 16.4 | *24087* | *19129* | *15865* | | | | |

## EXAMPLE OF THE USE OF THE TABLES STRENGTH OF STEEL COLUMNS OR STRUT

PAGES 194 TO 197.

What is the size of angle and plate column of soft steel requir support a load of 140 000 pounds? Length of column 25 feet; square; thickness of metal not to be less than $\frac{3}{8}''$ and depth of co not to exceed 9 inches.

Assume for trial a column composed of two web plates $9'' \times \frac{3}{8}''$ spaced 6″ out to out, with 4 angles, $3'' \times 2\frac{1}{2}''$ > riveted to the web plates and connected by latticing. This dis between the web plates is such that the moment of inertia abou axis parallel to the web plates is slightly greater than that abou axis perpendicular thereto.

Following the method indicated on page 159, the moment of in of the given section about an axis through the centre of gra perpendicular to the web plates, will be as follows:

$$I = 2\left(\frac{9^3 \times \frac{3}{8}}{12}\right) + 4\left\{1.04 + 1.92\,(4.5 - 0.71)^2\right\} = 160.0$$

The total area of column is 14.43 square inches and the radi gyration r is $\sqrt{\frac{160.04}{14.43}} = 3.33$ inches.

The ratio of the length of column in feet to the least radit gyration in inches is therefore $\frac{L}{r} = \frac{25}{3.33} = 7.50$. Referring to the "T of Strength of Steel Columns or Struts of Soft Steel," page 194 ultimate strength of a soft steel column in which $\frac{L}{r} = 7.50$ is 8 pounds per square inch. The safe unit strain for a quiescent lo one-fourth of this or 9 184 pounds per square inch, which multi by the area of the column, 14.43 square inches, gives a total safe of 132 525 pounds, which is slightly less than that specified.

Assume the angles to be increased to $3'' \times 2\frac{1}{2}'' \times \frac{7}{16}''$, th computation similar to the above gives I = 175.92, A = 1 $r = 3.36$, $\frac{L}{r} = 7.44$.

The safe load is equal to 9 210 pounds per square inch and the has been increased to 15.59 square inches, which gives as the total *load 143 584* pounds, which is slightly greater than required, sho *that the latter* combination is the one to be used.

# EXPLANATIONS OF TABLES RELATING TO DIMENSIONS AND SAFE LOADS FOR STEEL COLUMNS OF VARIOUS SECTIONS.

PAGES 200 TO 243, INCLUSIVE.

The principal dimensions of Z bar columns are given on page 200, and the safe loads therefor on pages 210 and 211. The principal dimensions of latticed channel columns are given on page 201, and the safe loads therefor on pages 212 to 215, inclusive. The safe loads for I-beams used as columns or struts are given on pages 206 to 209, inclusive, and the dimensions of these sections can be obtained from the tables on pages 28, 29 and 48. On pages 202 and 203 are given the principal dimensions of plate and channel columns with comparatively narrow plates called, for convenience of reference, Series A, the safe loads for which are given on pages 216 to 229, inclusive, and on pages 204 and 205 are given the principal dimensions of plate and channel columns with wider plates called, for convenience of reference, Series B, the safe loads for which are given on pages 230 to 243, inclusive.

The plate and channel columns given in Series A are particularly useful in buildings or locations in which it is desired to keep the extreme dimensions of the cross section as small as possible for this style of column, although in this series the radius of gyration about the central axis parallel to the channel webs is somewhat smaller than the radius of gyration about the axis perpendicular to the channel webs. This makes the narrower columns of Series A somewhat less economical of material than the wider columns of Series B, which, however, is small in amount for columns of ordinary story lengths of 10 feet to 14 feet, such as are used in skeleton buildings.

In Series B of plate and channel columns with wider plates, the radii of gyration about the two axes are practically equal for the intermediate thicknesses and these columns are slightly more economical of material than those of Series A, although they require somewhat more space on account of their wider sections.

The safe loads for columns of various kinds, as given on pages 206 to 243, inclusive, are expressed in thousands of pounds, and have been figured by the use of Gordon's formula, as stated at the heads of the various tables, using the safety factor 4, which relates to static or quiescent loads such as occur in ordinary buildings.

The loads of the tables are assumed to be central, and for eccentric loads or forces which might produce bending a proper allowance would have to be made, as the figures given in the tables cannot apply to such cases.

The safe loads of the various tables are figured for extreme ratios of 30 to 150 for $\frac{l}{r}$, in which l is the length of the column and r the least radius of gyration, both expressed in inches.

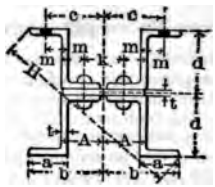
The weights of columns stated in the tables are per lineal foot of shaft, and do not include any allowance for bases, brackets or other connections, as these depend upon the particular details and requirements of each case.

Loads for other safety factors can be figured from the tables by inverse proportion, thus:

New safety factor : 4 : : load from tables : new loads.

Drawings of *typical details* of steel columns are given on pages 284 and 285.

## Z-BAR COLUMN DIMENSIONS.

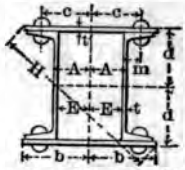



| Section of Column. | Thickness of Web-plate and Z-Bars. | a | b | d | H | c | K | n |
|---|---|---|---|---|---|---|---|---|
| | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inch |
| 4–3″ Z-Bars and 1 Web-plate 5¾″ wide. | 1/4 | 2 11/16 | 5 7/16 | 3 1/8 | 12 9/16 | 4 3/16 | 2 3/4 | 1 5 |
| | 5/16 | 2 3/4 | 5 7/16 | 3 3/32 | 12 5/8 | 4 1/8 | " | " |
| | 3/8 | 2 11/16 | 5 7/16 | 3 5/32 | 12 5/8 | 4 1/4 | " | " |
| | 7/16 | 2 3/4 | 5 7/16 | 3 9/32 | 12 1/2 | 4 3/16 | " | " |
| | 1/2 | 2 11/16 | 5 3/8 | 3 1/4 | 12 3/4 | 4 1/8 | " | " |
| | 9/16 | 2 3/4 | 5 7/16 | 3 11/32 | 12 7/16 | 4 1/16 | " | " |
| 4–4″ Z-Bars and 1 Web-plate 6¾″ wide. | 1/4 | 3 1/16 | 6 5/16 | 4 1/8 | 15 1/16 | 5 | 3 1/2 | 1 3 |
| | 5/16 | 3 1/8 | 6 5/16 | 4 7/32 | 15 1/16 | 4 15/16 | " | " |
| | 3/8 | 3 1/16 | 6 5/16 | 4 5/16 | 15 5/16 | 4 1/2 | " | " |
| | 7/16 | 3 1/8 | 6 1/4 | 4 3/8 | 14 7/8 | 4 3/16 | " | " |
| | 1/2 | 3 1/8 | 6 1/4 | 4 1/2 | 15 | 4 1/4 | " | " |
| | 9/16 | 3 3/16 | 6 1/8 | 4 13/32 | 15 1/8 | 4 1/16 | " | " |
| | 5/8 | 3 1/8 | 5 15/16 | 4 5/16 | 14 11/16 | 4 5/8 | " | " |
| | 11/16 | 3 1/8 | 5 15/16 | 4 3/8 | 14 3/8 | 4 5/16 | " | " |
| | 3/4 | 3 3/16 | 5 15/16 | 4 1/2 | 14 7/8 | 4 1/2 | " | " |
| 4–5″ Z-Bars and 1 Web-plate 7″ wide. | 5/16 | 3 1/4 | 6 9/16 | 5 5/32 | 16 11/16 | 5 3/16 | 3 1/2 | 1 7 |
| | 3/8 | 3 3/16 | 6 9/16 | 5 1/4 | 16 13/16 | 5 1/8 | " | " |
| | 7/16 | 3 1/4 | 6 9/16 | 5 11/32 | 16 15/16 | 5 1/16 | " | " |
| | 1/2 | 3 1/4 | 6 1/2 | 5 1/4 | 16 1/2 | 5 | " | " |
| | 9/16 | 3 5/16 | 6 1/2 | 5 13/32 | 16 5/8 | 4 15/16 | " | " |
| | 5/8 | 3 1/4 | 6 7/16 | 5 7/16 | 16 3/4 | 4 7/8 | " | " |
| | 11/16 | 3 1/4 | 6 7/16 | 5 1/2 | 16 7/8 | 4 13/16 | " | " |
| | 3/4 | 3 5/16 | 6 7/16 | 5 7/16 | 16 1/2 | 4 3/4 | " | " |
| | 13/16 | 3 3/8 | 6 7/16 | 5 17/32 | 16 5/8 | 4 11/16 | " | " |
| 4–6″ Z-Bars and 1 Web-plate 7¾″ wide. | 5/8 | 3 1/2 | 7 1/16 | 6 3/16 | 18 7/8 | 5 5/8 | 4 | 2 |
| | 11/16 | 3 9/16 | 7 1/16 | 6 9/32 | 19 | 5 9/16 | " | " |
| | 3/4 | 3 5/8 | 7 1/16 | 6 3/8 | 19 1/2 | 5 1/2 | " | " |
| | 13/16 | 3 1/2 | 6 15/16 | 6 9/32 | 18 3/4 | 5 7/16 | " | " |
| | 7/8 | 3 9/16 | 6 15/16 | 6 3/8 | 18 1/16 | 5 3/8 | " | " |
| | 15/16 | 3 5/8 | 6 15/16 | 6 13/32 | 19 | 5 5/16 | " | " |
| | 1 | 3 1/2 | 6 3/4 | 6 3/8 | 18 9/16 | 5 1/4 | " | " |
| | 1 1/16 | 3 9/16 | 6 3/4 | 6 13/32 | 18 11/16 | 5 1/16 | " | " |
| | 1 1/8 | 3 5/8 | 6 3/4 | 6 5/16 | 18 7/8 | 5 1/8 | " | " |

# DIMENSIONS FOR LATTICED CHANNEL COLUMNS.

| Depth of Channel and Section Number. | Weight per Foot. | t | b | d | H | c | E | A | m |
|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| 6″ C17 | 8.00 | .20 | 3¾ | 3 | 9 3/16 | 2⅞ | 1 13/16 | 2 | 1 1/16 |
| | 10.50 | .32 | " | " | " | " | 1 11/16 | " | 1 1/16 |
| | 13.00 | .44 | " | " | " | " | 1 9/16 | " | 1 1/16 |
| | 15.50 | .56 | " | " | " | " | 1 7/16 | " | 1 1/16 |
| 7″ C21 | 9.75 | .21 | 4¼ | 3½ | 11 | 3⅜ | 2 1/16 | 2⅜ | 1 1/16 |
| | 12.25 | .32 | " | " | " | " | 2 1/16 | " | 1 1/16 |
| | 14.75 | .42 | " | " | " | " | 1 15/16 | " | 1 1/16 |
| | 17.25 | .53 | " | " | " | " | 1 7/8 | " | 1 1/16 |
| | 19.75 | .63 | " | " | " | " | 1¾ | " | 1⅞ |
| 8″ C25 | 11.25 | .22 | 4 13/16 | 4 | 12½ | 3¾ | 2½ | 2¾ | 1¼ |
| | 13.75 | .31 | " | " | " | " | 2 7/16 | " | 1 5/16 |
| | 16.25 | .40 | " | " | " | " | 2 5/16 | " | 1 5/16 |
| | 18.75 | .49 | " | " | " | " | 2¼ | " | 1 5/16 |
| | 21.25 | .58 | " | " | " | " | 2 1/16 | " | 1 5/16 |
| 9″ C29 | 13.25 | .23 | 5 3/16 | 4½ | 13¾ | 4⅛ | 2¾ | 3 | 1⅜ |
| | 15.00 | .29 | " | " | " | " | 2 11/16 | " | 1 7/16 |
| | 20.00 | .45 | " | " | " | " | 2 5/16 | " | 1 5/16 |
| | 25.00 | .61 | " | " | " | " | 2⅛ | " | 1⅜ |
| 10″ C33 | 15.00 | .24 | 5¾ | 5 | 15¼ | 4⅝ | 3⅛ | 3⅜ | 1 1/16 |
| | 20.00 | .38 | " | " | " | " | 3 | " | 1 5/16 |
| | 25.00 | .53 | " | " | " | " | 2 7/8 | " | 1 5/16 |
| | 30.00 | .68 | " | " | " | " | 2 11/16 | " | 1 1/16 |
| | 35.00 | .82 | " | " | " | " | 2 5/16 | " | 2 1/16 |
| 12″ C41 | 20.50 | .28 | 6 11/16 | 6 | 18⅛ | 5⅝ | 3 7/8 | 4⅛ | 1⅜ |
| | 25.00 | .39 | " | " | " | " | 3 3/4 | " | 1 5/8 |
| | 30.00 | .51 | " | " | " | " | 3 5/8 | " | 2 |
| | 35.00 | .64 | " | " | " | " | 3 1/2 | " | 2 1/8 |
| | 40.00 | .76 | " | " | " | " | 3 3/8 | " | 2 1/4 |
| 15″ C53 | 33.00 | .40 | 8⅛ | 7½ | 22⅛ | 6⅝ | 4¾ | 5⅛ | 1 7/8 |
| | 35.00 | .43 | " | " | " | " | 4 11/16 | " | 1 15/16 |
| | 40.00 | .52 | " | " | " | " | 4 5/8 | " | 2 |
| | 45.00 | .62 | " | " | " | " | 4 1/2 | " | 2 1/8 |
| | 50.00 | .72 | " | " | " | " | 4 7/16 | " | 2 1/4 |
| | *55.00* | .82 | " | " | " | " | 4 5/16 | " | 2 5/16 |

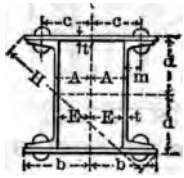
# DIMENSIONS FOR PLATE AND CHANNEL COLUMNS.




## SERIES A.

| Depth of Channel and Section No. | Weight per Foot. | Size of Plates. Width. | Size of Plates. Thickness. t′ | t | b | d | H | c | E | A |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| | 8.0 | 8 | 1/4 | .20 | 4 | 3 1/4 | 10 5/16 | 2 7/8 | 1 13/16 | 2 |
| | " | " | 5/16 | " | " | 3 5/16 | 10 7/16 | " | 1 11/16 | " |
| | 10.5 | " | 1/4 | .32 | " | 3 1/4 | 10 5/16 | " | 1 13/16 | " |
| 6″ | " | " | 5/16 | " | " | 3 5/16 | 10 7/16 | " | 1 11/16 | " |
| C17 | 13.0 | " | 1/4 | .44 | " | 3 1/4 | 10 5/16 | " | 1 9/16 | " |
| | " | " | 5/16 | " | " | 3 5/16 | 10 7/16 | " | 1 11/16 | " |
| | 15.5 | " | 1/4 | .56 | " | 3 1/4 | 10 5/16 | " | 1 7/16 | " |
| | " | " | 5/16 | " | " | 3 5/16 | 10 7/16 | " | 1 11/16 | " |
| | 9.75 | 9 | 1/4 | .21 | 4 1/2 | 3 3/4 | 11 3/4 | 3 1/4 | 2 1/16 | 2 1/4 |
| | " | " | 5/16 | " | " | 4 1/16 | 12 1/16 | " | 1 13/16 | " |
| | 12.25 | " | 1/4 | .32 | " | 3 3/4 | 11 3/4 | " | 1 13/16 | " |
| | " | " | 5/16 | " | " | 4 1/16 | 12 1/16 | " | 1 11/16 | " |
| 7″ | 14.75 | " | 1/4 | .42 | " | 3 3/4 | 11 3/4 | " | 1 13/16 | " |
| C21 | " | " | 5/16 | " | " | 4 1/16 | 12 1/16 | " | 1 11/16 | " |
| | 17.25 | " | 1/4 | .53 | " | 3 3/4 | 11 3/4 | " | 1 3/4 | " |
| | " | " | 5/16 | " | " | 4 1/16 | 12 1/16 | " | 1 11/16 | " |
| | 19.75 | " | 1/4 | .63 | " | 3 3/4 | 11 3/4 | " | 1 5/8 | " |
| | " | " | 5/16 | " | " | 4 1/16 | 12 1/16 | " | 1 11/16 | " |
| | 11.25 | 10 | 1/4 | .22 | 5 | 4 1/16 | 13 1/16 | 3 5/8 | 2 3/8 | 2 5/8 |
| | " | " | 5/16 | " | " | 4 5/16 | 13 5/16 | " | 1 11/16 | " |
| | 13.75 | " | 1/4 | .31 | " | 4 1/16 | 13 1/16 | " | 2 1/8 | " |
| | " | " | 5/16 | " | " | 4 5/16 | 13 5/16 | " | 1 11/16 | " |
| 8″ | 16.25 | " | 1/4 | .40 | " | 4 1/16 | 13 1/16 | " | 2 1/4 | " |
| C25 | " | " | 5/16 | " | " | 4 5/16 | 13 5/16 | " | 1 11/16 | " |
| | 18.75 | " | 1/4 | .49 | " | 4 1/16 | 13 1/16 | " | 2 1/8 | " |
| | " | " | 5/16 | " | " | 4 5/16 | 13 5/16 | " | 1 11/16 | " |
| | 21.25 | " | 1/4 | .58 | " | 4 1/16 | 13 1/16 | " | 2 1/16 | " |
| | " | " | 5/16 | " | " | 4 5/16 | 13 5/16 | " | 1 11/16 | " |
| | 13.25 | 11 | 1/4 | .23 | 5 1/2 | 4 3/4 | 14 1/16 | 4 1/8 | 2 3/4 | 3 |
| | " | " | 5/16 | " | " | 5 1/16 | 15 1/16 | " | 1 11/16 | " |
| | 15.00 | " | 1/4 | .29 | " | 4 3/4 | 14 1/16 | " | 2 1/16 | " |
| | " | " | 5/16 | " | " | 5 1/16 | 15 1/16 | " | 1 11/16 | " |
| 9″ | 20.00 | " | 1/4 | .45 | " | 4 3/4 | 14 1/16 | " | 2 5/16 | " |
| C29 | " | " | 5/16 | " | " | 5 1/16 | 15 1/16 | " | 1 11/16 | " |
| | 25.00 | " | 1/4 | .61 | " | 4 3/4 | 14 1/16 | " | 2 3/16 | " |
| | " | " | 5/16 | " | " | 5 1/16 | 15 1/16 | " | " | " |

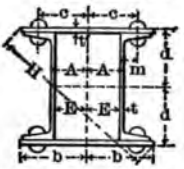
# DIMENSIONS FOR PLATE AND CHANNEL COLUMNS.




## SERIES A.

| ...th ...f ...nnel ...nd ...tion ...o. | Weight per Foot. | Size of Plates. Width. | Thickness, t' | t | b | d | H | c | E | A | m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| | 15.0 | 12 | 1/4 | .24 | 6 | 5 1/4 | 15 15/16 | 4 1/2 | 3 | 3 1/4 | 1 1/2 |
| | " | " | 5/16 | " | " | 5 5/16 | 16 7/16 | " | " | " | " |
| | 20.0 | " | 1/4 | .38 | " | 5 1/4 | 15 15/16 | " | 2 7/8 | " | 1 5/8 |
| | " | " | 5/16 | " | " | 5 5/16 | 16 7/16 | " | " | " | " |
| 0" | 25.0 | " | 1/4 | .53 | " | 5 1/4 | 15 15/16 | " | 2 3/4 | " | 1 3/4 |
| 33 | " | " | 5/16 | " | " | 5 5/16 | 16 7/16 | " | " | " | " |
| | 30.0 | " | 1/4 | .68 | " | 5 1/4 | 15 15/16 | " | 2 5/8 | " | 1 11/16 |
| | " | " | 5/16 | " | " | 5 5/16 | 16 7/16 | " | " | " | " |
| | 35.0 | " | 1/4 | .82 | " | 5 1/4 | 15 15/16 | " | 2 7/16 | " | 2 1/16 |
| | " | " | 5/16 | " | " | 5 5/16 | 16 7/16 | " | " | " | " |
| | 20.5 | 14 | 1/4 | .28 | 7 | 6 1/4 | 18 3/4 | 5 5/8 | 3 7/8 | 4 1/8 | 1 3/4 |
| | " | " | 5/16 | " | " | 6 5/16 | 19 5/16 | " | " | " | " |
| | 25.0 | " | 1/4 | .39 | " | 6 1/4 | 18 3/4 | " | 3 3/4 | " | 1 7/8 |
| | " | " | 5/16 | " | " | 6 5/16 | 19 5/16 | " | " | " | " |
| 2" | 30.0 | " | 1/4 | .51 | " | 6 1/4 | 18 3/4 | " | 3 5/8 | " | 2 |
| 41 | " | " | 5/16 | " | " | 6 5/16 | 19 5/16 | " | " | " | " |
| | 35.0 | " | 1/4 | .64 | " | 6 1/4 | 18 3/4 | " | 3 1/2 | " | 2 1/8 |
| | " | " | 5/16 | " | " | 6 5/16 | 19 5/16 | " | " | " | " |
| | 40.0 | " | 1/4 | .76 | " | 6 1/4 | 18 3/4 | " | 3 3/8 | " | 2 1/4 |
| | " | " | 5/16 | " | " | 6 5/16 | 19 5/16 | " | " | " | " |
| | 33.0 | 17 | 3/16 | .40 | 8 1/2 | 7 7/8 | 23 3/16 | 6 3/4 | 4 7/8 | 5 1/4 | 1 7/8 |
| | " | " | 3/8 | " | " | 8 1/4 | 23 11/16 | " | " | " | " |
| | 35.0 | " | 3/16 | .43 | " | 7 7/8 | 23 3/16 | " | 4 13/16 | " | 1 15/16 |
| | " | " | 5/16 | " | " | 8 1/4 | 23 11/16 | " | " | " | " |
| 5" | 40.0 | " | 3/16 | .52 | " | 7 7/8 | 23 3/16 | " | 4 3/4 | " | 2 |
| 53 | " | " | 5/16 | " | " | 8 1/4 | 23 11/16 | " | " | " | " |
| | 45.0 | " | 3/16 | .62 | " | 7 7/8 | 23 3/16 | " | 4 5/8 | " | 2 1/16 |
| | " | " | 5/16 | " | " | 8 1/4 | 23 11/16 | " | " | " | " |
| | 50.0 | " | 3/16 | .72 | " | 7 7/8 | 23 3/16 | " | 4 9/16 | " | 2 1/16 |
| | " | " | 5/16 | " | " | 8 1/4 | 23 11/16 | " | " | " | " |
| | 55.0 | " | 3/16 | .82 | " | 7 7/8 | 23 3/16 | " | 4 7/16 | " | 2 1/16 |
| | " | " | 5/16 | " | " | 8 1/4 | 23 11/16 | " | " | " | " |

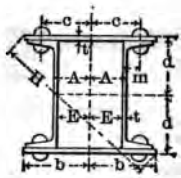
# DIMENSIONS FOR PLATE AND CHANN COLUMNS.




## SERIES B.

| Depth of Channel and Section No. | Weight per Foot. | Size of Plates. Width. | Size of Plates. Thickness, t' | t | b | d | H | δ | E | A |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches |
| | 8 | 9 | 1/4 | .20 | 4 1/2 | 3 1/4 | 11 1/8 | 3 3/8 | 2 5/16 | 2 1/2 |
| | " | " | 5/16 | " | " | 3 5/16 | 11 1/8 | " | " | " |
| | 10.5 | " | 1/4 | .32 | " | 3 1/4 | 11 1/8 | " | 2 3/16 | " |
| 6" | " | " | 5/16 | " | " | 3 5/16 | 11 1/8 | " | " | " |
| C17 | 13.0 | " | 1/4 | .44 | " | 3 1/4 | 11 1/8 | " | 2 1/16 | " |
| | " | " | 5/16 | " | " | 3 5/16 | 11 1/8 | " | " | " |
| | 15.5 | " | 1/4 | .56 | " | 3 1/4 | 11 1/8 | " | 1 15/16 | " |
| | " | " | 5/16 | " | " | 3 5/16 | 11 1/8 | " | " | " |
| | 9.75 | 11 | 1/4 | .21 | 5 1/2 | 3 3/4 | 13 5/16 | 4 1/4 | 3 1/16 | 3 1/4 |
| | " | " | 5/16 | " | " | 4 1/16 | 13 3/4 | " | " | " |
| | 12.25 | " | 1/4 | .32 | " | 3 3/4 | 13 5/16 | " | 2 15/16 | " |
| | " | " | 5/16 | " | " | 4 1/16 | 13 3/4 | " | " | " |
| 7" | 14.75 | " | 1/4 | .42 | " | 3 3/4 | 13 5/16 | " | 2 13/16 | " |
| C21 | " | " | 5/16 | " | " | 4 1/16 | 13 3/4 | " | " | " |
| | 17.25 | " | 1/4 | .53 | " | 3 3/4 | 13 5/16 | " | 2 3/4 | " |
| | " | " | 5/16 | " | " | 4 1/16 | 13 3/4 | " | " | " |
| | 19.75 | " | 1/4 | .63 | " | 3 3/4 | 13 5/16 | " | 2 5/16 | " |
| | " | " | 5/16 | " | " | 4 1/16 | 13 3/4 | " | " | " |
| | 11.25 | 12 | 1/4 | .22 | 6 | 4 1/4 | 14 11/16 | 4 5/8 | 3 7/16 | 3 5/8 |
| | " | " | 5/16 | " | " | 4 5/16 | 15 1/2 | " | " | " |
| | 13.75 | " | 1/4 | .31 | " | 4 1/4 | 14 11/16 | " | 3 5/16 | " |
| | " | " | 5/16 | " | " | 4 5/16 | 15 1/2 | " | " | " |
| 8" | 16.25 | " | 1/4 | .40 | " | 4 1/4 | 14 11/16 | " | 3 1/4 | " |
| C25 | " | " | 5/16 | " | " | 4 5/16 | 15 1/2 | " | " | " |
| | 18.75 | " | 1/4 | .49 | " | 4 1/4 | 14 11/16 | " | 3 1/8 | " |
| | " | " | 5/16 | " | " | 4 5/16 | 15 1/2 | " | " | " |
| | 21.25 | " | 1/4 | .58 | " | 4 1/4 | 14 11/16 | " | 3 1/16 | " |
| | " | " | 5/16 | " | " | 4 5/16 | 15 1/2 | " | " | " |
| | 13.25 | 13 | 1/4 | .23 | 6 1/2 | 4 3/4 | 16 1/16 | 5 1/8 | 3 3/4 | 4 |
| | " | " | 5/16 | " | " | 5 1/16 | 16 9/16 | " | " | " |
| 9" | 15.00 | " | 1/4 | .29 | " | 4 3/4 | 16 1/16 | " | 3 11/16 | " |
| C29 | " | " | 5/16 | " | " | 5 1/16 | 16 9/16 | " | " | " |
| | 20.00 | " | 1/4 | .45 | " | 4 3/4 | 16 1/16 | " | 3 5/8 | " |
| | " | " | 5/16 | " | " | 5 1/16 | 16 9/16 | " | " | " |
| | 25.00 | " | 1/4 | .61 | " | 4 3/4 | 16 1/16 | " | 3 5/8 | " |
| | " | " | 5/16 | " | " | 5 1/16 | 16 9/16 | " | " | " |

# DIMENSIONS FOR PLATE AND CHANNEL COLUMNS.




## SERIES B.

| Depth of Channel and Section No. | Weight per Foot. | Size of Plates. Width. | Size of Plates. Thickness. t' | t | b | d | H | c | E | A | m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| | 15.0 | 15 | 1/4 | .24 | 7 1/2 | 5 1/4 | 18 5/16 | 6 | 4 1/2 | 4 3/4 | 1 1/2 |
| | " | " | 5/16 | " | " | 5 5/16 | 18 3/4 | " | " | " | " |
| | 20.0 | " | 1/4 | .38 | " | 5 1/4 | 18 5/16 | " | 4 3/8 | " | 1 5/8 |
| | " | " | 5/16 | " | " | 5 5/16 | 18 3/4 | " | " | " | " |
| 10" | 25.0 | " | 1/4 | .53 | " | 5 1/4 | 18 5/16 | " | 4 1/4 | " | 1 3/4 |
| C33 | " | " | 5/16 | " | " | 5 5/16 | 18 3/4 | " | " | " | " |
| | 30.0 | " | 1/4 | .68 | " | 5 1/4 | 18 5/16 | " | 4 1/16 | " | 1 15/16 |
| | " | " | 5/16 | " | " | 5 5/16 | 18 3/4 | " | " | " | " |
| | 35.0 | " | 1/4 | .82 | " | 5 1/4 | 18 5/16 | " | 3 15/16 | " | 2 1/16 |
| | " | " | 5/16 | " | " | 5 5/16 | 18 3/4 | " | " | " | " |
| | 20.5 | 16 | 1/4 | .28 | 8 | 6 1/4 | 20 5/16 | 6 5/8 | 4 7/8 | 5 1/8 | 1 3/4 |
| | " | " | 5/16 | " | " | 6 5/16 | 20 3/4 | " | " | " | " |
| | 25.0 | " | 1/4 | .39 | " | 6 1/4 | 20 5/16 | " | 4 3/4 | " | 1 7/8 |
| 12" | " | " | 5/16 | " | " | 6 5/16 | 20 3/4 | " | " | " | " |
| C41 | 30.0 | " | 1/4 | .51 | " | 6 1/4 | 20 5/16 | " | 4 5/8 | " | 2 |
| | " | " | 5/16 | " | " | 6 5/16 | 20 3/4 | " | " | " | " |
| | 35.0 | " | 1/4 | .64 | " | 6 1/4 | 20 5/16 | " | 4 1/2 | " | 2 1/8 |
| | " | " | 5/16 | " | " | 6 5/16 | 20 3/4 | " | " | " | " |
| | 40.0 | " | 1/4 | .76 | " | 6 1/4 | 20 5/16 | " | 4 3/8 | " | 2 1/4 |
| | " | " | 5/16 | " | " | 6 5/16 | 20 3/4 | " | " | " | " |
| | 33.0 | 20 | 3/8 | .40 | 10 | 7 7/16 | 25 7/16 | 8 1/4 | 6 3/8 | 6 3/4 | 1 7/8 |
| | " | " | 7/16 | " | " | 8 1/4 | 25 15/16 | " | " | " | " |
| | 35.0 | " | 3/8 | .43 | " | 7 7/16 | 25 7/16 | " | 6 5/16 | " | 1 15/16 |
| | " | " | 7/16 | " | " | 8 1/4 | 25 15/16 | " | " | " | " |
| 15" | 40.0 | " | 3/8 | .52 | " | 7 7/16 | 22 7/16 | " | 6 1/4 | " | 2 |
| C53 | " | " | 7/16 | " | " | 8 1/4 | 25 15/16 | " | " | " | " |
| | 45.0 | " | 3/8 | .62 | " | 7 7/16 | 25 7/16 | " | 6 1/8 | " | 2 1/8 |
| | " | " | 7/16 | " | " | 8 1/4 | 25 15/16 | " | " | " | " |
| | 50.0 | " | 3/8 | .72 | " | 7 7/16 | 25 7/16 | " | 6 1/16 | " | 2 1/4 |
| | " | " | 7/16 | " | " | 8 1/4 | 25 15/16 | " | " | " | " |
| | 55.0 | " | 3/8 | .82 | " | 7 7/16 | 25 7/16 | " | 5 15/16 | " | 2 5/16 |
| | " | " | 7/16 | " | " | 8 1/4 | 25 15/16 | " | " | " | " |

# SAFE LOADS IN THOUSANDS OF POUNDS FOR I-BEAMS USED AS COLUMNS WITH SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**

| Depth of Beam and Section Number. | Weight per Foot. | Area of Section. | Least Radius of Gyration. | Length in Feet. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Sq. Ins. | Inches. | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 3″ B5 | 5.5 | 1.63 | .53 | 19 | 18 | 17 | 15 | 13 | 12 | 11 |
| | 6.5 | 1.91 | .52 | 23 | 21 | 19 | 17 | 16 | 14 | 12 |
| | 7.5 | 2.21 | .52 | 26 | 24 | 22 | 20 | 18 | 16 | 14 |
| 4″ B9 | 7.5 | 2.21 | .59 | 26 | 25 | 23 | 21 | 20 | 18 | 16 |
| | 8.5 | 2.50 | .58 | 30 | 28 | 26 | 24 | 22 | 20 | 18 |
| | 9.5 | 2.79 | .58 | 33 | 31 | 29 | 27 | 24 | 22 | 20 |
| | 10.5 | 3.09 | .57 | 37 | 35 | 32 | 29 | 27 | 24 | 22 |
| 5″ B13 | 9.75 | 2.87 | .65 | 35 | 33 | 31 | 29 | 27 | 24 | 22 |
| | 12.25 | 3.60 | .63 | 43 | 41 | 39 | 36 | 33 | 30 | 27 |
| | 14.75 | 4.34 | .63 | 52 | 50 | 47 | 43 | 40 | 36 | 33 |
| 6″ B17 | 12.25 | 3.61 | .72 | 44 | 42 | 40 | 38 | 35 | 33 | 30 |
| | 14.75 | 4.34 | .69 | 52 | 51 | 48 | 45 | 42 | 39 | 35 |
| | 17.25 | 5.07 | .68 | 61 | 59 | 56 | 52 | 48 | 44 | 41 |
| 7″ B21 | 15.0 | 4.42 | .78 | 54 | 52 | 50 | 47 | 45 | 42 | 39 |
| | 17.5 | 5.15 | .76 | 63 | 61 | 58 | 55 | 52 | 48 | 45 |
| | 20.0 | 5.88 | .74 | 71 | 69 | 66 | 62 | 58 | 54 | 50 |
| 8″ B25 | 17.75 | 5.33 | .84 | 65 | 63 | 61 | 58 | 55 | 52 | 49 |
| | 20.25 | 5.96 | .82 | 73 | 71 | 68 | 65 | 61 | 58 | 54 |
| | 22.75 | 6.69 | .81 | 82 | 79 | 76 | 72 | 69 | 65 | 60 |
| | 25.25 | 7.43 | .80 | 91 | 88 | 84 | 80 | 76 | 71 | 66 |
| 9″ B29 | 21.0 | 6.31 | .90 | 77 | 76 | 73 | 70 | 67 | 63 | 60 |
| | 25.0 | 7.35 | .88 | 90 | 88 | 85 | 81 | 78 | 73 | 69 |
| | 30.0 | 8.82 | .85 | 108 | 105 | 101 | 97 | 92 | 87 | 81 |
| | 35.0 | 10.29 | .84 | 126 | 122 | 118 | 112 | 107 | 101 | 95 |
| 10″ B33 | 25.0 | 7.37 | .97 | 91 | 89 | 86 | 83 | 80 | 76 | 73 |
| | 30.0 | 8.82 | .93 | 108 | 106 | 103 | 99 | 94 | 90 | 85 |
| | 35.0 | 10.29 | .91 | 126 | 123 | 119 | 115 | 110 | 104 | 98 |
| | 40.0 | 11.76 | .90 | 144 | 141 | 136 | 131 | 125 | 118 | 112 |
| 12″ B41 | 31.5 | 9.26 | 1.01 | 114 | 112 | 109 | 105 | 102 | 97 | 93 |
| | 35.0 | 10.29 | .99 | 127 | 124 | 121 | 117 | 112 | 107 | 102 |
| | 40.0 | 11.76 | .96 | 144 | 142 | 137 | 133 | 127 | 121 | 115 |

# SAFE LOADS IN THOUSANDS OF POUNDS FOR I-BEAMS USED AS COLUMNS WITH SQUARE ENDS.

**Based on Gordon's Formula** $P = \frac{50\,000}{1 + \frac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**

| Length in Feet. | | | | | | | | | Weight per Foot. | Depth of Beam and Section Number. |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | Pounds. | |
| 9 | ... | ... | ... | ... | ... | ... | ... | ... | 5.5 | 3″ B5 |
| 11 | ... | ... | ... | ... | ... | ... | ... | ... | 6.5 | |
| 13 | ... | ... | ... | ... | ... | - | ... | ... | 7.5 | |
| 14 | 13 | ... | ... | ... | ... | ... | ... | ... | 7.5 | 4″ B9 |
| 16 | 14 | ... | ... | ... | ... | ... | ... | ... | 8.5 | |
| 18 | 16 | ... | ... | ... | ... | ... | ... | ... | 9.5 | |
| 19 | 17 | ... | ... | ... | ... | ... | ... | ... | 10.5 | |
| 20 | 18 | 17 | ... | ... | ... | ... | ... | ... | 9.75 | 5″ B13 |
| 25 | 22 | 20 | ... | ... | ... | ... | ... | ... | 12.25 | |
| 30 | 27 | 24 | ... | ... | ... | ... | ... | ... | 14.75 | |
| 28 | 25 | 23 | 21 | ... | ... | ... | ... | ... | 12.25 | 6″ B17 |
| 32 | 29 | 27 | 25 | ... | ... | ... | ... | ... | 14.75 | |
| 37 | 34 | 31 | 28 | ... | ... | ... | ... | ... | 17 25 | |
| 36 | 33 | 31 | 28 | 26 | ... | ... | ... | ... | 15.0 | 7″ B21 |
| 41 | 38 | 35 | 32 | 30 | ... | ... | ... | ... | 17.5 | |
| 46 | 43 | 39 | 36 | 33 | ... | ... | ... | ... | 20.0 | |
| 46 | 43 | 40 | 37 | 34 | 31 | ... | ... | ... | 17.75 | 8″ B25 |
| 50 | 47 | 43 | 40 | 37 | 34 | ... | ... | ... | 20.25 | |
| 56 | 52 | 48 | 45 | 41 | 38 | ... | ... | ... | 22.75 | |
| 61 | 57 | 53 | 49 | 45 | 42 | ... | ... | ... | 25.25 | |
| 56 | 53 | 49 | 46 | 43 | 40 | 37 | ... | ... | 21.0 | 9″ B29 |
| 65 | 60 | 57 | 53 | 49 | 46 | 43 | ... | ... | 25.0 | |
| 76 | 71 | 66 | 61 | 57 | 53 | 49 | ... | ... | 30.0 | |
| 88 | 82 | 76 | 71 | 66 | 61 | 56 | ... | ... | 35.0 | |
| 68 | 65 | 61 | 57 | 54 | 50 | 47 | 44 | ... | 25.0 | 10″ B33 |
| 80 | 75 | 71 | 66 | 62 | 58 | 54 | 50 | ... | 30.0 | |
| 92 | 87 | 81 | 76 | 71 | 66 | 62 | 57 | ... | 35.0 | |
| 105 | 98 | 92 | 86 | 80 | 74 | 69 | 65 | ... | 40.0 | |
| 88 | 83 | 78 | 74 | 69 | 65 | 61 | 58 | 54 | 31.5 | 12″ B41 |
| 97 | 91 | 86 | 81 | 76 | 72 | 67 | 63 | 59 | 35.0 | |
| 109 | 103 | *96* | *90* | *85* | 79 | 74 | 69 | 65 | 40.0 | |

# SAFE LOADS IN THOUSANDS OF POUNDS FOR I-BEAMS USED AS COLUMNS WITH SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**

| Depth of Beam and Section Number. | Weight per Foot. | Area of Section. | Least Radius of Gyration. | Length in Feet. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pounds. | Sq. Ins. | Inches. | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 12″ B105 | 40.0 | 11.84 | 1.08 | 146 | 144 | 140 | 136 | 132 | 127 | 121 | 11 |
| | 45.0 | 13.24 | 1.06 | 163 | 160 | 156 | 152 | 146 | 141 | 135 | 13 |
| | 50.0 | 14.71 | 1.05 | 181 | 178 | 174 | 168 | 163 | 156 | 149 | 14 |
| | 55.0 | 16.18 | 1.04 | 199 | 196 | 191 | 185 | 178 | 171 | 163 | 15 |
| 15″ B 53 | 42.0 | 12.48 | 1.08 | 154 | 151 | 148 | 144 | 139 | 133 | 128 | 12 |
| | 45.0 | 13.24 | 1.07 | 163 | 160 | 157 | 152 | 147 | 142 | 135 | 13 |
| | 50.0 | 14.71 | 1.04 | 181 | 178 | 174 | 168 | 162 | 156 | 149 | 14 |
| | 55.0 | 16.18 | 1.03 | 199 | 196 | 191 | 185 | 178 | 171 | 163 | 15 |
| | 60.0 | 17.65 | 1.01 | 217 | 213 | 207 | 201 | 194 | 185 | 177 | 16 |
| 15″ B109 | 60.0 | 17.67 | 1.21 | 218 | 215 | 212 | 207 | 201 | 195 | 188 | 18 |
| | 65.0 | 19.12 | 1.20 | 236 | 233 | 229 | 223 | 217 | 211 | 203 | 19 |
| | 70.0 | 20.59 | 1.19 | 254 | 251 | 246 | 240 | 234 | 226 | 218 | 20 |
| | 75.0 | 22.06 | 1.18 | 273 | 269 | 264 | 258 | 250 | 242 | 233 | 22 |
| | 80.0 | 23.53 | 1.17 | 291 | 286 | 281 | 274 | 266 | 257 | 248 | 23 |
| 15″ B113 | 80.0 | 23.57 | 1.32 | 292 | 289 | 284 | 279 | 273 | 265 | 256 | 24 |
| | 85.0 | 25.00 | 1.32 | 309 | 306 | 302 | 295 | 289 | 281 | 272 | 26 |
| | 90.0 | 26.47 | 1.32 | 328 | 324 | 319 | 313 | 306 | 297 | 288 | 27 |
| | 95.0 | 27.94 | 1.31 | 346 | 342 | 336 | 330 | 322 | 314 | 304 | 29 |
| | 100.0 | 29.41 | 1.31 | 364 | 360 | 354 | 348 | 339 | 330 | 320 | 30 |
| 18″ B 65 | 55.0 | 15.93 | 1.15 | 197 | 194 | 190 | 185 | 180 | 173 | 166 | 15 |
| | 60.0 | 17.65 | 1.13 | 218 | 214 | 210 | 205 | 198 | 191 | 184 | 17 |
| | 65.0 | 19.12 | 1.11 | 236 | 232 | 227 | 221 | 214 | 206 | 198 | 19 |
| | 70.0 | 20.59 | 1.09 | 254 | 250 | 244 | 237 | 230 | 221 | 212 | 20 |
| 20″ B 73 | 65.0 | 19.08 | 1.21 | 236 | 233 | 229 | 223 | 217 | 210 | 203 | 19 |
| | 70.0 | 20.59 | 1.19 | 254 | 251 | 246 | 240 | 234 | 226 | 218 | 21 |
| | 75.0 | 22.06 | 1.17 | 273 | 268 | 264 | 257 | 250 | 241 | 233 | 22 |
| 20″ B121 | 80.0 | 23.73 | 1.39 | 294 | 291 | 287 | 282 | 276 | 270 | 261 | 25 |
| | 85.0 | 25.00 | 1.37 | 309 | 307 | 302 | 297 | 290 | 283 | 275 | 26 |
| | 90.0 | 26.47 | 1.36 | 328 | 325 | 320 | 314 | 307 | 300 | 290 | 28 |
| | 95.0 | 27.94 | 1.35 | 346 | 343 | 337 | 331 | 324 | 315 | 307 | 29 |
| | 100.0 | 29.41 | 1.34 | 364 | 361 | 355 | 349 | 340 | 332 | 321 | 31 |
| 24″ B 89 | 80.0 | 23.32 | 1.36 | 289 | 286 | 282 | 276 | 271 | 264 | 256 | 24 |
| | 85.0 | 25.00 | 1.33 | 309 | 306 | 302 | 295 | 289 | 281 | 273 | 26 |
| | 90.0 | 26.47 | 1.31 | 328 | 324 | 319 | 313 | 305 | 297 | 288 | 27 |
| | 95.0 | 27.94 | 1.30 | 346 | 342 | 336 | 330 | 322 | 313 | 303 | 29 |
| | 100.0 | 29.41 | 1.28 | 364 | 360 | 354 | 347 | 338 | 328 | 317 | 30 |

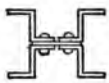
# SAFE LOADS IN THOUSANDS OF POUNDS FOR I-BEAMS USED AS COLUMNS WITH SQUARE ENDS.

**Based on Gordon's Formula** $P = \frac{50\,000}{1 + \frac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**

| Length in Feet. | | | | | | | | Weight per Foot. | Depth of Beam and Section Number. |
|---|---|---|---|---|---|---|---|---|---|
| 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Pounds. | |
| 99 | 94 | 88 | 83 | 79 | 75 | 70 | . . . | 40.0 | |
| 110 | 103 | 98 | 92 | 87 | 82 | 77 | . . . | 45.0 | 12″ |
| 121 | 114 | 108 | 101 | 96 | 90 | 85 | . . . | 50.0 | B105 |
| 132 | 124 | 117 | 111 | 104 | 98 | 92 | . . . | 55.0 | |
| 105 | 99 | 93 | 88 | 83 | 79 | 74 | . . . | 42.0 | |
| 110 | 104 | 98 | 93 | 87 | 82 | 78 | . . . | 45.0 | 15″ |
| 120 | 113 | 106 | 101 | 94 | 89 | 84 | . . . | 50.0 | B 53 |
| 131 | 124 | 116 | 109 | 103 | 97 | 91 | . . . | 55.0 | |
| 141 | 132 | 124 | 117 | 110 | 104 | 97 | . . . | 60.0 | |
| 159 | 152 | 144 | 137 | 130 | 124 | 117 | 111 | 60.0 | |
| 171 | 163 | 154 | 147 | 140 | 132 | 126 | 120 | 65.0 | 15″ |
| 183 | 174 | 165 | 157 | 150 | 142 | 135 | 127 | 70.0 | B109 |
| 195 | 186 | 176 | 168 | 158 | 151 | 142 | 135 | 75.0 | |
| 206 | 197 | 187 | 178 | 168 | 160 | 151 | 143 | 80.0 | |
| 221 | 213 | 203 | 194 | 186 | 177 | 169 | 161 | 80.0 | |
| 235 | 226 | 216 | 206 | 197 | 188 | 180 | 171 | 85.0 | 15″ |
| 249 | 239 | 228 | 218 | 209 | 199 | 190 | 181 | 90.0 | B113 |
| 261 | 251 | 240 | 228 | 219 | 208 | 199 | 190 | 95.0 | |
| 275 | 264 | 252 | 240 | 230 | 219 | 210 | 200 | 100.0 | |
| 139 | 132 | 125 | 119 | 112 | 106 | 100 | 95 | 55.0 | |
| 152 | 144 | 137 | 129 | 122 | 116 | 110 | 104 | 60.0 | 18″ |
| 163 | 154 | 146 | 138 | 131 | 123 | 117 | 110 | 65.0 | B 65 |
| 173 | 164 | 155 | 146 | 138 | 130 | 123 | 116 | 70.0 | |
| 171 | 164 | 155 | 148 | 141 | 134 | 126 | 120 | 65.0 | |
| 183 | 174 | 165 | 157 | 150 | 142 | 135 | 127 | 70.0 | 20″ |
| 194 | 185 | 175 | 167 | 158 | 150 | 142 | 135 | 75.0 | B 73 |
| 229 | 219 | 211 | 202 | 194 | 186 | 177 | 169 | 80.0 | |
| 239 | 230 | 221 | 212 | 202 | 194 | 185 | 176 | 85.0 | 20″ |
| 253 | 241 | 232 | 223 | 213 | 204 | 195 | 185 | 90.0 | B121 |
| 265 | 255 | 244 | 234 | 223 | 214 | 205 | 195 | 95.0 | |
| 278 | 267 | 257 | 245 | 235 | 223 | 214 | 203 | 100.0 | |
| 223 | 213 | 205 | 196 | 187 | 179 | 172 | 163 | 80.0 | |
| 236 | 226 | 217 | 207 | 198 | 189 | 181 | 172 | 85.0 | 24″ |
| 247 | 238 | 227 | 216 | 207 | 197 | 189 | 180 | 90.0 | B 89 |
| 261 | 249 | 239 | 228 | 218 | 207 | 198 | 188 | 95.0 | |
| 272 | 260 | 249 | 238 | 226 | 215 | 205 | 196 | 100.0 | |

# SAFE LOADS IN THOUSANDS OF POUNDS FOR Z-BAR COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**

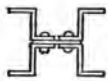


| Section of Column. | Thickness of Web-plate and Z-Bars. | Area of Column Section. | Weight of Column per Foot. | Least Radius of Gyration. | Length in Feet. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Inches. | Sq. Ins. | Pounds. | Inches. | 4 | 6 | 8 | 10 | 12 | 14 |
| 4–3″ Z-Bars and 1 Web-plate 5¾″ wide. | ¼ | 9.31 | 31.7 | 1.86 | 114 | 112 | 108 | 104 | 100 | 95 |
| | 5/16 | 11.72 | 39.7 | 1.91 | 144 | 141 | 137 | 132 | 126 | 121 |
| | 3/8 | 13.59 | 46.1 | 1.88 | 167 | 163 | 158 | 153 | 146 | 139 |
| | 7/16 | 15.97 | 54.2 | 1.93 | 196 | 192 | 187 | 180 | 173 | 165 |
| | ½ | 17.62 | 59.8 | 1.90 | 216 | 212 | 206 | 198 | 190 | 181 |
| | 9/16 | 19.97 | 67.8 | 1.95 | 245 | 240 | 234 | 226 | 216 | 207 |
| 4–4″ Z-Bars and 1 Web-plate 6¾″ wide. | ¼ | 11.31 | 38.5 | 2.46 | 140 | 138 | 135 | 132 | 129 | 125 |
| | 5/16 | 14.22 | 48.4 | 2.51 | 176 | 174 | 171 | 167 | 163 | 158 |
| | 3/8 | 17.16 | 58.2 | 2.56 | 212 | 210 | 207 | 202 | 197 | 191 |
| | 7/16 | 19.14 | 65.2 | 2.49 | 237 | 234 | 230 | 225 | 219 | 213 |
| | ½ | 22.00 | 74.7 | 2.54 | 272 | 269 | 265 | 259 | 253 | 245 |
| | 9/16 | 24.89 | 84.5 | 2.59 | 308 | 305 | 300 | 293 | 287 | 279 |
| | 5/8 | 26.41 | 89.9 | 2.52 | 327 | 323 | 317 | 310 | 302 | 293 |
| | 11/16 | 29.22 | 99.4 | 2.57 | 362 | 358 | 352 | 344 | 336 | 327 |
| | ¾ | 32.06 | 109.2 | 2.62 | 397 | 392 | 386 | 379 | 369 | 360 |
| 4–5″ Z-Bars and 1 Web-plate 7″ wide. | 5/16 | 15.78 | 52.8 | 3.08 | . . . | 194 | 192 | 189 | 186 | 182 |
| | 3/8 | 19.03 | 64.5 | 3.13 | . . . | 234 | 232 | 229 | 225 | 220 |
| | 7/16 | 22.31 | 76.0 | 3.18 | . . . | 275 | 272 | 269 | 264 | 259 |
| | ½ | 24.50 | 83.5 | 3.10 | . . . | 302 | 298 | 294 | 289 | 283 |
| | 9/16 | 27.70 | 94.2 | 3.15 | . . . | 341 | 338 | 333 | 327 | 321 |
| | 5/8 | 30.94 | 105.3 | 3.21 | . . . | 381 | 377 | 372 | 367 | 359 |
| | 11/16 | 32.66 | 111.2 | 3.13 | . . . | 402 | 398 | 392 | 386 | 378 |
| | ¾ | 35.81 | 121.9 | 3.18 | . . . | 441 | 437 | 431 | 423 | 415 |
| | 13/16 | 39.00 | 132.5 | 3.24 | . . . | 481 | 476 | 469 | 462 | 454 |
| 4–6″ Z-Bars and 1 Web-plate 7¾″ wide. | 3/8 | 21.28 | 72.3 | 3.68 | . . . | 263 | 261 | 258 | 255 | 251 |
| | 7/16 | 24.94 | 84.7 | 3.73 | . . . | 309 | 306 | 303 | 299 | 295 |
| | ½ | 28.62 | 97.2 | 3.78 | . . . | 354 | 352 | 348 | 344 | 339 |
| | 9/16 | 31.08 | 105.6 | 3.70 | . . . | 385 | 381 | 377 | 373 | 367 |
| | 5/8 | 34.69 | 118.1 | 3.75 | . . . | 429 | 426 | 421 | 417 | 411 |
| | 11/16 | 38.33 | 130.5 | 3.73 | . . . | 474 | 471 | 466 | 460 | 453 |
| | ¾ | 40.31 | 137.0 | 3.67 | . . . | 499 | 494 | 490 | 483 | 476 |
| | 13/16 | 43.87 | 149.0 | 3.65 | . . . | 543 | 538 | 533 | 525 | 519 |
| | ⅞ | 47.47 | 161.5 | 3.63 | . . . | 587 | 582 | 575 | 569 | 559 |

For detail dimensions see page 200.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR Z-BAR COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36000\,r^2}}$ **Safety factor 4.**



| Length in Feet. | | | | | | | | | | | Thickness of Web-plate and Z-Bars. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | Inches. |
| 90 | 85 | 79 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 1/4 |
| 114 | 108 | 102 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 5/16 |
| 132 | 124 | 117 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 3/8 |
| 157 | 148 | 139 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 7/16 |
| 172 | 162 | 153 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 1/2 |
| 197 | 186 | 175 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 9/16 |
| 121 | 117 | 112 | 107 | 102 | 98 | . . . | . . . | . . . | . . . | . . . | 1/4 |
| 153 | 147 | 142 | 136 | 130 | 124 | . . . | . . . | . . . | . . . | . . . | 5/16 |
| 186 | 179 | 173 | 166 | 158 | 151 | . . . | . . . | . . . | . . . | . . . | 3/8 |
| 206 | 198 | 190 | 183 | 175 | 167 | . . . | . . . | . . . | . . . | . . . | 7/16 |
| 237 | 229 | 220 | 211 | 203 | 194 | . . . | . . . | . . . | . . . | . . . | 1/2 |
| 270 | 260 | 251 | 241 | 231 | 222 | . . . | . . . | . . . | . . . | . . . | 9/16 |
| 285 | 275 | 264 | 253 | 243 | 232 | . . . | . . . | . . . | . . . | . . . | 5/8 |
| 317 | 305 | 294 | 282 | 271 | 259 | . . . | . . . | . . . | . . . | . . . | 11/16 |
| 349 | 337 | 326 | 313 | 299 | 288 | . . . | . . . | . . . | . . . | . . . | 3/4 |
| 178 | 174 | 169 | 164 | 159 | 154 | 148 | 143 | 138 | 133 | . . . | 5/8 |
| 215 | 210 | 204 | 199 | 192 | 186 | 181 | 174 | 168 | 161 | . . . | 3/8 |
| 254 | 247 | 241 | 234 | 228 | 220 | 213 | 206 | 198 | 191 | . . . | 7/16 |
| 276 | 270 | 262 | 255 | 248 | 239 | 231 | 223 | 215 | 206 | . . . | 1/2 |
| 314 | 306 | 299 | 289 | 281 | 271 | 263 | 254 | 245 | 236 | . . . | 9/16 |
| 352 | 344 | 335 | 325 | 316 | 306 | 297 | 287 | 276 | 267 | . . . | 5/8 |
| 370 | 360 | 351 | 341 | 330 | 320 | 310 | 298 | 288 | 277 | . . . | 11/16 |
| 407 | 396 | 386 | 376 | 365 | 353 | 342 | 331 | 318 | 307 | . . . | 3/4 |
| 445 | 433 | 423 | 411 | 400 | 388 | 376 | 362 | 350 | 338 | . . . | 13/16 |
| 248 | 243 | 238 | 233 | 228 | 221 | 216 | 210 | 204 | 199 | 192 | 3/4 |
| 290 | 285 | 279 | 274 | 268 | 261 | 254 | 248 | 241 | 234 | 227 | 7/8 |
| 334 | 328 | 322 | 315 | 309 | 300 | 293 | 286 | 278 | 270 | 263 | 15/16 |
| 362 | 354 | 348 | 341 | 332 | 325 | 316 | 308 | 300 | 290 | 282 | 1 |
| 404 | 397 | 390 | 381 | 373 | 364 | 354 | 345 | 336 | 326 | 317 | 1 1/8 |
| 446 | 439 | 429 | 421 | 412 | 401 | 391 | 381 | 370 | 360 | 348 | 1 1/4 |
| 468 | 460 | 451 | 440 | 431 | 419 | 409 | 397 | 387 | 374 | 364 | 1 3/4 |
| 509 | 500 | 489 | 479 | 467 | 456 | 443 | 432 | 419 | 407 | 394 | 1 3/8 |
| 551 | 539 | 529 | 516 | 505 | 491 | 480 | 465 | 453 | 438 | 426 | 1 1/2 |

*For detail dimensions see page 200.*

# SAFE LOADS IN THOUSANDS OF POUNDS FOR LATTICED CHANNEL COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**

| Depth of Channels. | Weight of each Channel. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Inches. | Lbs. per Foot. | Sq. Ins. | Inches. | 4 | 6 | 8 | 10 | 12 | 14 |
| 6 | 8.0 | 4.76 | 2.34 | 59 | 58 | 57 | 55 | 54 | 52 |
| " | 10.5 | 6.18 | 2.21 | 76 | 75 | 73 | 71 | 69 | 67 |
| " | 13.0 | 7.64 | 2.13 | 94 | 93 | 90 | 88 | 85 | 81 |
| " | 15.5 | 9.12 | 2.06 | 112 | 110 | 107 | 104 | 100 | 96 |
| 7 | 9.75 | 5.70 | 2.72 | 71 | 70 | 69 | 68 | 66 | 65 |
| " | 12.25 | 7.20 | 2.59 | 89 | 88 | 87 | 85 | 83 | 81 |
| " | 14.75 | 8.68 | 2.50 | 107 | 106 | 104 | 102 | 99 | 96 |
| " | 17.25 | 10.14 | 2.44 | 125 | 124 | 121 | 119 | 116 | 112 |
| " | 19.75 | 11.62 | 2.39 | 144 | 142 | 139 | 136 | 132 | 128 |
| 8 | 11.25 | 6.70 | 3.11 | 83 | 83 | 82 | 80 | 79 | 77 |
| " | 13.75 | 8.08 | 2.99 | 100 | 99 | 98 | 97 | 95 | 93 |
| " | 16.25 | 9.56 | 2.89 | 119 | 117 | 116 | 114 | 112 | 109 |
| " | 18.75 | 11.02 | 2.82 | 137 | 135 | 134 | 131 | 128 | 125 |
| " | 21.25 | 12.50 | 2.77 | 155 | 153 | 151 | 149 | 145 | 142 |
| 9 | 13.25 | 7.78 | 3.45 | . . . | 96 | 95 | 94 | 93 | 91 |
| " | 15.00 | 8.82 | 3.37 | . . . | 109 | 108 | 107 | 105 | 103 |
| " | 20.00 | 11.76 | 3.20 | . . . | 145 | 143 | 142 | 139 | 137 |
| " | 25.00 | 14.70 | 3.08 | . . . | 181 | 179 | 177 | 173 | 170 |
| 10 | 15.0 | 8.92 | 3.84 | . . . | 110 | 110 | 109 | 107 | 106 |
| " | 20.0 | 11.76 | 3.66 | . . . | 146 | 144 | 143 | 141 | 139 |
| " | 25.0 | 14.70 | 3.52 | . . . | 182 | 180 | 178 | 176 | 173 |
| " | 30.0 | 17.64 | 3.41 | . . . | 218 | 216 | 213 | 210 | 207 |
| " | 35.0 | 20.58 | 3.31 | . . . | 254 | 251 | 248 | 245 | 240 |
| 12 | 20.5 | 12.06 | 4.61 | . . . | . . . | 149 | 148 | 147 | 146 |
| " | 25.0 | 14.70 | 4.43 | . . . | . . . | 181 | 180 | 179 | 177 |
| " | 30.0 | 17.64 | 4.28 | . . . | . . . | 217 | 216 | 214 | 211 |
| " | 35.0 | 20.58 | 4.17 | . . . | . . . | 254 | 251 | 249 | 246 |
| " | 40.0 | 23.52 | 4.09 | . . . | . . . | 289 | 287 | 284 | 281 |
| 15 | 33.0 | 19.80 | 5.59 | . . . | . . . | 246 | 244 | 243 | 241 |
| " | 35.0 | 20.58 | 5.56 | . . . | . . . | 255 | 254 | 252 | 251 |
| " | 40.0 | 23.52 | 5.44 | . . . | . . . | 291 | 290 | 288 | 286 |
| " | 45.0 | 26.48 | 5.32 | . . . | . . . | 328 | 326 | 324 | 322 |
| " | 50.0 | 29.42 | 5.23 | . . . | . . . | 364 | 363 | 360 | 357 |
| " | 55.0 | 32.36 | 5.16 | . . . | . . . | 400 | 399 | 396 | 393 |

For detail dimensions see page 201.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR LATTICED CHANNEL COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36000\,r^2}}$. **Safety factor 4.**

| Length in Feet. | | | | | | | | Weight of each Channel, | Depth of Channels, |
|---|---|---|---|---|---|---|---|---|---|
| 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | Lbs. per Foot. | Inches. |
| 50 | 48 | 46 | 44 | 42 | . . . | . . . | . . . | 8.0 | 6 |
| 64 | 61 | 58 | 55 | 52 | . . . | . . . | . . . | 10.5 | " |
| 78 | 74 | 71 | 67 | 63 | . . . | . . . | . . . | 13.0 | " |
| 92 | 88 | 83 | 78 | 74 | . . . | . . . | . . . | 15.5 | " |
| 63 | 61 | 58 | 56 | 54 | 52 | . . . | . . . | 9.75 | 7 |
| 78 | 76 | 73 | 70 | 67 | 64 | . . . | . . . | 12.25 | " |
| 93 | 90 | 86 | 83 | 79 | 76 | . . . | . . . | 14.75 | " |
| 108 | 104 | 100 | 96 | 92 | 87 | . . . | . . . | 17.25 | " |
| 123 | 119 | 113 | 108 | 104 | 98 | . . . | . . . | 19.75 | " |
| 76 | 74 | 72 | 70 | 68 | 65 | 63 | 61 | 11.25 | 8 |
| 90 | 88 | 86 | 83 | 80 | 78 | 75 | 72 | 13.75 | " |
| 107 | 104 | 100 | 97 | 94 | 90 | 87 | 83 | 16.25 | " |
| 122 | 118 | 115 | 111 | 107 | 103 | 99 | 95 | 18.75 | " |
| 138 | 134 | 129 | 124 | 120 | 115 | 111 | 106 | 21.25 | " |
| 90 | 88 | 86 | 84 | 82 | 80 | 77 | 75 | 13.25 | 9 |
| 101 | 99 | 97 | 94 | 92 | 90 | 87 | 84 | 15.00 | " |
| 134 | 131 | 127 | 124 | 120 | 116 | 113 | 109 | 20.00 | " |
| 166 | 162 | 157 | 153 | 149 | 143 | 139 | 134 | 25.00 | " |
| 104 | 102 | 101 | 99 | 97 | 95 | 93 | 90 | 15.0 | 10 |
| 136 | 134 | 131 | 128 | 125 | 122 | 119 | 116 | 20.0 | " |
| 170 | 166 | 163 | 159 | 155 | 151 | 146 | 143 | 25.0 | " |
| 203 | 198 | 194 | 189 | 185 | 179 | 174 | 168 | 30.0 | " |
| 236 | 230 | 225 | 219 | 213 | 207 | 201 | 194 | 35.0 | " |
| 144 | 142 | 140 | 138 | 136 | 134 | 131 | 129 | 20.5 | 12 |
| 175 | 172 | 170 | 167 | 165 | 161 | 159 | 155 | 25.0 | " |
| 209 | 206 | 203 | 200 | 196 | 192 | 187 | 184 | 30.0 | " |
| 243 | 240 | 236 | 231 | 227 | 223 | 218 | 213 | 35.0 | " |
| 277 | 273 | 268 | 263 | 258 | 253 | 248 | 243 | 40.0 | " |
| 240 | 238 | 235 | 233 | 230 | 228 | 225 | 222 | 33.0 | 15 |
| 249 | 247 | 245 | 242 | 240 | 236 | 234 | 230 | 35.0 | " |
| 284 | 282 | 279 | 276 | 273 | 269 | 266 | 262 | 40.0 | " |
| 319 | 316 | 313 | 310 | 306 | 302 | 298 | 294 | 45.0 | " |
| 354 | 352 | 348 | 344 | 339 | 334 | 329 | 325 | 50.0 | " |
| 390 | 386 | 381 | 377 | 372 | 368 | 362 | 357 | 55.0 | " |

*For detail dimensions* see page 201.

# SAFE LOADS IN THOUSANDS OF POUNDS LATTICED CHANNEL COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor**

| Depth of Channels. | Weight of each Channel. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | |
|---|---|---|---|---|---|---|---|
| Inches. | Lbs. per Foot. | Sq. Ins. | Inches. | 32 | 34 | 36 | 38 |
| 9 | 13.25 | 7.78 | 3.45 | 73 | 71 | . . . . | . . . . |
| " | 15.00 | 8.82 | 3.37 | 81 | 79 | . . . . | . . . . |
| " | 20.00 | 11.76 | 3.20 | 106 | 101 | . . . . | . . . . |
| " | 25.00 | 14.70 | 3.08 | 129 | 124 | . . . . | . . . . |
| 10 | 15.0 | 8.92 | 3.84 | 87 | 85 | 83 | . . . . |
| " | 20.0 | 11.76 | 3.66 | 113 | 109 | 106 | . . . . |
| " | 25.0 | 14.70 | 3.52 | 138 | 134 | 130 | . . . . |
| " | 30.0 | 17.64 | 3.41 | 163 | 158 | 153 | . . . . |
| " | 35.0 | 20.58 | 3.31 | 188 | 183 | 176 | . . . . |
| 12 | 20.5 | 12.06 | 4.61 | 127 | 124 | 121 | 119 |
| " | 25.0 | 14.70 | 4.43 | 152 | 149 | 146 | 142 |
| " | 30.0 | 17.64 | 4.28 | 180 | 176 | 172 | 167 |
| " | 35.0 | 20.58 | 4.17 | 208 | 203 | 199 | 193 |
| " | 40.0 | 23.52 | 4.09 | 236 | 231 | 224 | 218 |
| 15 | 33.0 | 19.80 | 5.59 | 219 | 215 | 213 | 209 |
| " | 35.0 | 20.58 | 5.56 | 228 | 224 | 220 | 217 |
| " | 40.0 | 23.52 | 5.44 | 258 | 254 | 250 | 246 |
| " | 45.0 | 26.48 | 5.32 | 289 | 284 | 279 | 275 |
| " | 50.0 | 29.42 | 5.23 | 320 | 315 | 309 | 303 |
| " | 55.0 | 32.36 | 5.16 | 351 | 344 | 338 | 332 |

For detail dimensions see page 201.

# SIZE OF LATTICE BARS TO BE USED WI LATTICED CHANNEL COLUMNS.

| Depth of Channels. | Dimensions of Lattice Bars. | | Weight of Lattice Bars per Foot. | Center of Hole to End of Bar. (a) | Distance Center to of Rivets. (d | |
|---|---|---|---|---|---|---|
| | w | Thickness. | | | Maximum. | Mini |
| Inches. | Inches. | Inches. | Pounds. | Inches. | | |
| 6 | 1 1/2 | 1/4 | 1.28 | 1 1/8 | 0'—11 1/8" | |
| 7 | 1 3/4 | 1/4 | 1.49 | 1 1/8 | 1'— 1 1/8" | |
| 8 | 2 | 1/4 | 2.12 | 1 1/4 | 1'— 3" | |
| 9 | 2 | 5/16 | 2.12 | 1 1/4 | 1'— 4 1/8" | |
| 10 | 2 | 5/16 | 2.55 | 1 1/4 | 1'— 6 1/8" | 1 |
| 12 | 2 1/4 | 5/16 | 2.87 | 1 3/8 | 1'—10 1/8" | 1 |
| 15 | 2 1/2 | 3/8 | 3.19 | 1 1/2 | 2'— 2 1/4" | 1 |

## FE LOADS IN THOUSANDS OF POUNDS FOR LATTICED CHANNEL COLUMNS. SQUARE ENDS.

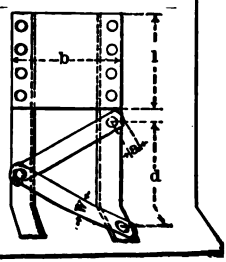
**Based on Gordon's Formula** $P = \frac{50\,000}{1 + \frac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**

| Length in Feet. | | | | | | | Weight of each Channel. | Depth of Channels. |
|---|---|---|---|---|---|---|---|---|
| 2 | 44 | 46 | 48 | 50 | 52 | 54 | Lbs. per Foot. | Inches. |
| . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 13.25 | 9 |
| . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 15.00 | " |
| . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 20.00 | " |
| . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 25.00 | " |
| . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 15.0 | 10 |
| . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 20.0 | " |
| | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 25.0 | " |
| | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 30.0 | " |
| . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 35.0 | " |
| 13 | 111 | 108 | . . . . | . . . . | . . . . | . . . . | 20.5 | 12 |
| 35 | 132 | 128 | . . . . | . . . . | . . . . | . . . . | 25.0 | " |
| 59 | 155 | 151 | . . . . | . . . . | . . . . | . . . . | 30.0 | " |
| 83 | 178 | 173 | . . . . | . . . . | . . . . | . . . . | 35.0 | " |
| 06 | 200 | 196 | . . . . | . . . . | . . . . | . . . . | 40.0 | " |
| 02 | 199 | 195 | 192 | 188 | 184 | 181 | 33.0 | 15 |
| 10 | 206 | 203 | 199 | 194 | 191 | 187 | 35.0 | " |
| 38 | 233 | 228 | 224 | 220 | 215 | 211 | 40.0 | " |
| 65 | 260 | 255 | 250 | 245 | 239 | 234 | 45.0 | " |
| 93 | 287 | 281 | 275 | 269 | 264 | 258 | 50.0 | " |
| 19 | 314 | 307 | 301 | 294 | 287 | 281 | 55.0 | " |

For detail dimensions see page 201.

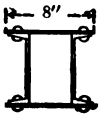
## SIZE OF STAY PLATES TO BE USED WITH LATTICED CHANNEL COLUMNS.

| Minimum Size of Stay Plates at Ends of Columns. | | | Weight of Minimum Stay Plates. | Diameter of Rivets. |
|---|---|---|---|---|
| b | Thickness. | l | | |
| ches. | Inches. | Inches. | Pounds. | Inches. |
| 8¼ | ½ | 7½ | 4.38 | ⅝ |
| 9¼ | ½ | 10 | 6.55 | ⅝ |
| 0½ | ½ | 9 | 8.37 | ⅝ |
| 1½ | ½ | 12 | 11.95 | ⅝ |
| 2¼ | ⅝ | 12 | 15.62 | ⅝ |
| 4½ | ⅝ | 15 | 22.73 | ⅝ |
| 6¼ | ⅝ | 15 | 25.90 | ¾ |



# SAFE LOADS IN THOUSANDS OF POUNDS
## 6″ CHANNEL AND PLATE COLUMNS.
## SQUARE ENDS.

**Based on Gordon's Formula** $P = \frac{50\,000}{1 + \frac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor**




## SERIES A.

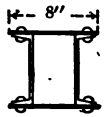
| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Fee | | |
|---|---|---|---|---|---|---|---|
| Lbs. per Foot. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches | 4 | 6 | 8 |
| 8 | ¼ | 29.6 | 8.76 | 2.35 | 108 | 107 | 105 |
| " | 5/16 | 33.0 | 9.76 | 2.35 | 121 | 119 | 117 |
| " | 3/8 | 36.4 | 10.76 | 2.34 | 133 | 131 | 129 |
| " | 7/16 | 39.8 | 11.76 | 2.34 | 145 | 143 | 141 |
| " | ½ | 43.2 | 12.76 | 2.34 | 158 | 155 | 152 |
| " | 9/16 | 46.6 | 13.76 | 2.34 | 170 | 167 | 164 |
| " | 5/8 | 50.0 | 14.76 | 2.33 | 182 | 180 | 176 |
| 10.5 | ¼ | 34.6 | 10.18 | 2.27 | 126 | 124 | 121 |
| " | 5/16 | 38.0 | 11.18 | 2.27 | 138 | 136 | 133 |
| " | 3/8 | 41.4 | 12.18 | 2.28 | 150 | 148 | 145 |
| " | 7/16 | 44.8 | 13.18 | 2.28 | 163 | 160 | 157 |
| " | ½ | 48.2 | 14.18 | 2.28 | 175 | 173 | 169 |
| " | 9/16 | 51.6 | 15.18 | 2.28 | 187 | 185 | 181 |
| " | 5/8 | 55.0 | 16.18 | 2.28 | 200 | 197 | 193 |
| 13 | ¼ | 39.6 | 11.64 | 2.20 | 144 | 141 | 138 |
| " | 5/16 | 43.0 | 12.64 | 2.21 | 156 | 154 | 150 |
| " | 3/8 | 46.4 | 13.64 | 2.22 | 168 | 166 | 162 |
| " | 7/16 | 49.8 | 14.64 | 2.23 | 181 | 178 | 174 |
| " | ½ | 53.2 | 15.64 | 2.23 | 193 | 190 | 186 |
| " | 9/16 | 56.6 | 16.64 | 2.24 | 205 | 202 | 198 |
| " | 5/8 | 60.0 | 17.64 | 2.24 | 218 | 214 | 210 |
| 15.5 | ¼ | 44.6 | 13.12 | 2.14 | 162 | 159 | 155 |
| " | 5/16 | 48.0 | 14.12 | 2.15 | 174 | 171 | 167 |
| " | 3/8 | 51.4 | 15.12 | 2.16 | 186 | 183 | 179 |
| " | 7/16 | 54.8 | 16.12 | 2.17 | 199 | 195 | 191 |
| " | ½ | 58.2 | 17.12 | 2.18 | 211 | 207 | 203 |
| " | 9/16 | 61.6 | 18.12 | 2.19 | 224 | 220 | 215 |
| " | 5/8 | 65.0 | 19.12 | 2.19 | 236 | 232 | 227 |

For detail dimensions see page 252.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 6″ CHANNEL AND PLATE COLUMNS.

## SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**



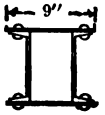

## SERIES A.

| Length in Feet. | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|
| 12 | 14 | 16 | 18 | 20 | 22 | 24 | Inches. | Lbs. per Foot. |
| 99 | 96 | 92 | 89 | 85 | 81 | 77 | 1/4 | 8 |
| 111 | 107 | 103 | 99 | 95 | 90 | 86 | 5/16 | " |
| 122 | 118 | 114 | 109 | 104 | 99 | 94 | 3/8 | " |
| 133 | 128 | 124 | 119 | 114 | 109 | 103 | 7/16 | " |
| 144 | 139 | 135 | 129 | 124 | 118 | 112 | 1/2 | " |
| 156 | 150 | 145 | 139 | 133 | 127 | 121 | 9/16 | " |
| 166 | 161 | 155 | 149 | 142 | 136 | 130 | 5/8 | " |
| 114 | 110 | 106 | 102 | 97 | 92 | 88 | 1/4 | 10.5 |
| 126 | 121 | 117 | 112 | 107 | 102 | 96 | 5/16 | " |
| 137 | 133 | 127 | 122 | 116 | 111 | 106 | 3/8 | " |
| 148 | 143 | 138 | 132 | 126 | 120 | 114 | 7/16 | " |
| 159 | 154 | 148 | 142 | 135 | 130 | 123 | 1/2 | " |
| 171 | 165 | 159 | 152 | 144 | 139 | 132 | 9/16 | " |
| 182 | 176 | 169 | 162 | 154 | 148 | 140 | 5/8 | " |
| 130 | 125 | 120 | 115 | 109 | 104 | 99 | 1/4 | 13 |
| 141 | 136 | 131 | 125 | 119 | 113 | 107 | 5/16 | " |
| 153 | 147 | 141 | 135 | 129 | 122 | 116 | 3/8 | " |
| 164 | 158 | 152 | 145 | 138 | 131 | 125 | 7/16 | " |
| 175 | 169 | 162 | 155 | 148 | 140 | 133 | 1/2 | " |
| 186 | 179 | 173 | 166 | 158 | 150 | 143 | 9/16 | " |
| 197 | 190 | 183 | 176 | 167 | 159 | 151 | 5/8 | " |
| 146 | 140 | 134 | 128 | 122 | 115 | 109 | 1/4 | 15.5 |
| 157 | 151 | 145 | 138 | 131 | 125 | 118 | 5/16 | " |
| 170 | 162 | 155 | 148 | 140 | 133 | 127 | 3/8 | " |
| 180 | 172 | 165 | 158 | 150 | 143 | 135 | 7/16 | " |
| 191 | 184 | 176 | 168 | 160 | 152 | 144 | 1/2 | " |
| 202 | 195 | 187 | 178 | 170 | 162 | 153 | 9/16 | " |
| 213 | 205 | 197 | 188 | 180 | 171 | 161 | 5/8 | " |

*For detail dimensions see page 202.*

# SAFE LOADS IN THOUSANDS OF POUNDS FO
## 7″ CHANNEL AND PLATE COLUMNS.
## SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**




## SERIES A.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | |
|---|---|---|---|---|---|---|---|---|
| Lbs. per Foot. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 4 | 6 | 8 | 1( |
| 9.75 | ¼ | 34.8 | 10.20 | 2.63 | 126 | 125 | 123 | 12 |
| " | 5/16 | 38.6 | 11.32 | 2.63 | 140 | 139 | 137 | 13 |
| " | 3/8 | 42.5 | 12.45 | 2.62 | 154 | 152 | 150 | 14 |
| " | 7/16 | 46.3 | 13.58 | 2.62 | 168 | 166 | 163 | 16 |
| " | ½ | 50.1 | 14.70 | 2.62 | 182 | 180 | 177 | 17 |
| " | 9/16 | 53.9 | 15.82 | 2.62 | 196 | 194 | 190 | 18 |
| " | 5/8 | 57.8 | 16.95 | 2.62 | 210 | 207 | 204 | 20 |
| 12.25 | ¼ | 39.8 | 11.70 | 2.55 | 145 | 143 | 141 | 13 |
| " | 5/16 | 43.6 | 12.82 | 2.56 | 159 | 157 | 154 | 15 |
| " | 3/8 | 47.5 | 13.95 | 2.56 | 173 | 171 | 168 | 16 |
| " | 7/16 | 51.3 | 15.08 | 2.56 | 187 | 185 | 182 | 17 |
| " | ½ | 55.1 | 16.20 | 2.57 | 200 | 198 | 195 | 19 |
| " | 9/16 | 58.9 | 17.32 | 2.57 | 214 | 212 | 208 | 20 |
| " | 5/8 | 62.8 | 18.45 | 2.57 | 228 | 226 | 222 | 21 |
| 14.75 | ¼ | 44.8 | 13.18 | 2.49 | 168 | 161 | 158 | 15 |
| " | 5/16 | 48.6 | 14.30 | 2.50 | 177 | 175 | 172 | 16 |
| " | 3/8 | 52.5 | 15.43 | 2.50 | 191 | 189 | 185 | 18 |
| " | 7/16 | 56.3 | 16.56 | 2.51 | 205 | 202 | 199 | 19 |
| " | ½ | 60.1 | 17.68 | 2.52 | 219 | 216 | 212 | 20 |
| " | 9/16 | 63.9 | 18.80 | 2.52 | 233 | 230 | 226 | 22 |
| " | 5/8 | 67.8 | 19.93 | 2.53 | 247 | 244 | 239 | 23 |
| 17.25 | ¼ | 49.8 | 14.64 | 2.42 | 181 | 178 | 175 | 17 |
| " | 5/16 | 53.6 | 15.76 | 2.43 | 195 | 192 | 189 | 18 |
| " | 3/8 | 57.5 | 16.89 | 2.45 | 209 | 206 | 202 | 19 |
| " | 7/16 | 61.3 | 18.02 | 2.46 | 223 | 220 | 216 | 21 |
| " | ½ | 65.1 | 19.14 | 2.46 | 237 | 234 | 229 | 22 |
| " | 9/16 | 68.9 | 20.26 | 2.47 | 251 | 248 | 243 | 23 |
| " | 5/8 | 72.8 | 21.39 | 2.48 | 265 | 261 | 257 | 25 |
| 19.75 | ¼ | 54.8 | 16.12 | 2.37 | 199 | 197 | 193 | 18 |
| " | 5/16 | 58.6 | 17.24 | 2.38 | 213 | 210 | 206 | 20 |
| " | 3/8 | 62.5 | 18.37 | 2.40 | 227 | 224 | 220 | 21 |
| " | 7/16 | 66.3 | 19.50 | 2.41 | 241 | 238 | 234 | 22 |
| " | ½ | 70.1 | 20.62 | 2.42 | 255 | 251 | 247 | 24 |
| " | 9/16 | 73.9 | 21.74 | 2.43 | 269 | 265 | 260 | 25 |
| " | 5/8 | 77.8 | 22.87 | 2.44 | 283 | 279 | 274 | 26 |

For detail dimensions see page 292.

# ...DS IN THOUSANDS OF POUNDS FOR ...ANNEL AND PLATE COLUMNS.

## SQUARE ENDS.

**Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**

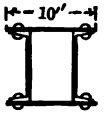
## SERIES A.

| Length in Feet. | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|
| 18 | 20 | 22 | 24 | 26 | Inches. | Lbs. per Ft. |
| 108 | 104 | 99 | 96 | 92 | ¼ | 9.75 |
| 119 | 115 | 110 | 106 | 102 | 5/16 | " |
| 131 | 126 | 121 | 116 | 112 | ⅜ | " |
| 143 | 138 | 132 | 127 | 122 | 7/16 | " |
| 154 | 149 | 143 | 137 | 132 | ½ | " |
| 166 | 161 | 154 | 148 | 142 | 9/16 | " |
| 178 | 172 | 165 | 158 | 152 | ⅝ | " |
| 122 | 118 | 113 | 108 | 103 | ¼ | 12.25 |
| 134 | 129 | 124 | 118 | 113 | 5/16 | " |
| 146 | 140 | 135 | 129 | 123 | ⅜ | " |
| 158 | 152 | 145 | 139 | 133 | 7/16 | " |
| 169 | 163 | 156 | 150 | 144 | ½ | " |
| 181 | 174 | 167 | 161 | 154 | 9/16 | " |
| 193 | 185 | 178 | 171 | 164 | ⅝ | " |
| 136 | 131 | 126 | 120 | 115 | ¼ | 14.75 |
| 148 | 142 | 136 | 131 | 125 | 5/16 | " |
| 160 | 154 | 147 | 141 | 135 | ⅜ | " |
| 171 | 165 | 158 | 151 | 144 | 7/16 | " |
| 184 | 177 | 170 | 162 | 155 | ½ | " |
| 196 | 188 | 180 | 173 | 165 | 9/16 | " |
| 207 | 199 | 191 | 183 | 175 | ⅝ | " |
| 150 | 143 | 137 | 131 | 126 | ¼ | 17.25 |
| 162 | 155 | 148 | 142 | 135 | 5/16 | " |
| 174 | 166 | 159 | 153 | 146 | ⅜ | " |
| 186 | 178 | 171 | 163 | 155 | 7/16 | " |
| 197 | 190 | 182 | 173 | 165 | ½ | " |
| 209 | 201 | 192 | 184 | 176 | 9/16 | " |
| 220 | 212 | 203 | 194 | 186 | ⅝ | " |
| 164 | 157 | 150 | 143 | 136 | ¼ | 19.7 |
| 175 | 168 | 161 | 153 | 146 | 5/16 | " |
| 187 | 180 | 172 | 164 | 157 | ⅜ | " |
| 199 | 191 | 183 | 174 | 166 | 7/16 | " |
| 211 | 202 | 194 | 185 | 177 | ½ | " |
| 223 | 214 | 204 | 195 | 186 | 9/16 | " |
| 235 | 225 | 216 | 207 | 196 | ⅝ | " |

For detail dimensions see page 221.

# SAFE LOADS IN THOUSANDS OF POUNDS FO 8" CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**



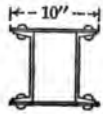

## SERIES A.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Foot. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 4 | 6 | 8 | 10 | 1 |
| 11.25 | 1/4 | 39.5 | 11.70 | 2.98 | 145 | 144 | 142 | 140 | 1 |
| " | 5/16 | 43.7 | 12.95 | 2.97 | 161 | 159 | 157 | 155 | 1 |
| " | 3/8 | 48.0 | 14.20 | 2.97 | 176 | 175 | 172 | 170 | 1 |
| " | 7/16 | 52.3 | 15.45 | 2.96 | 192 | 190 | 188 | 185 | 1 |
| " | 1/2 | 56.5 | 16.70 | 2.95 | 207 | 205 | 203 | 200 | 1 |
| " | 9/16 | 60.8 | 17.95 | 2.95 | 223 | 221 | 219 | 214 | 2 |
| " | 5/8 | 65.0 | 19.20 | 2.95 | 238 | 236 | 233 | 229 | 2 |
| 13.75 | 1/4 | 44.5 | 13.08 | 2.92 | 162 | 161 | 159 | 156 | 1 |
| " | 5/16 | 48.7 | 14.33 | 2.92 | 178 | 176 | 174 | 171 | 1 |
| " | 3/8 | 53.0 | 15.58 | 2.92 | 193 | 191 | 189 | 186 | 1 |
| " | 7/16 | 57.3 | 16.83 | 2.91 | 209 | 207 | 204 | 201 | 1 |
| " | 1/2 | 61.5 | 18.08 | 2.91 | 224 | 222 | 220 | 216 | 2 |
| " | 9/16 | 65.8 | 19.33 | 2.91 | 240 | 237 | 235 | 231 | 2 |
| " | 5/8 | 70.0 | 20.58 | 2.91 | 255 | 253 | 250 | 246 | 2 |
| 16.25 | 1/4 | 49.5 | 14.56 | 2.86 | 181 | 179 | 176 | 173 | 1 |
| " | 5/16 | 53.7 | 15.81 | 2.87 | 196 | 194 | 192 | 188 | 1 |
| " | 3/8 | 58.0 | 17.06 | 2.87 | 212 | 210 | 207 | 203 | 1 |
| " | 7/16 | 62.3 | 18.31 | 2.87 | 227 | 225 | 222 | 218 | 2 |
| " | 1/2 | 66.5 | 19.56 | 2.87 | 243 | 240 | 237 | 233 | 2 |
| " | 9/16 | 70.8 | 20.81 | 2.87 | 258 | 256 | 252 | 248 | 2 |
| " | 5/8 | 75.0 | 22.06 | 2.87 | 274 | 271 | 267 | 263 | 2 |
| 18.75 | 1/4 | 54.5 | 16.02 | 2.81 | 199 | 197 | 194 | 190 | 1 |
| " | 5/16 | 58.7 | 17.27 | 2.81 | 214 | 212 | 209 | 205 | 2 |
| " | 3/8 | 63.0 | 18.52 | 2.82 | 230 | 227 | 224 | 221 | 2 |
| " | 7/16 | 67.3 | 19.77 | 2.82 | 245 | 243 | 240 | 236 | 2 |
| " | 1/2 | 71.5 | 21.02 | 2.83 | 261 | 258 | 255 | 250 | 2 |
| " | 9/16 | 75.8 | 22.27 | 2.83 | 276 | 274 | 270 | 265 | 2 |
| " | 5/8 | 80.0 | 23.52 | 2.83 | 292 | 289 | 285 | 280 | 2 |
| 21.25 | 1/4 | 59.5 | 17.50 | 2.76 | 217 | 215 | 212 | 208 | 2 |
| " | 5/16 | 63.7 | 18.75 | 2.77 | 233 | 230 | 227 | 223 | 2 |
| " | 3/8 | 68.0 | 20.00 | 2.77 | 248 | 245 | 242 | 238 | 2 |
| " | 7/16 | 72.3 | 21.25 | 2.78 | 264 | 261 | 257 | 253 | 2 |
| " | 1/2 | 76.5 | 22.50 | 2.79 | 279 | 276 | 272 | 267 | 2 |
| " | 9/16 | 80.8 | 23.75 | 2.79 | 295 | 291 | 287 | 282 | 2 |
| " | 5/8 | 85.0 | 25.00 | 2.80 | 310 | 307 | 302 | 297 | 2 |

For detail dimensions see page 222.

# E LOADS IN THOUSANDS OF POUNDS FOR 8″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

sed on Gordon's Formula $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. Safety factor 4.



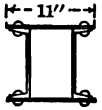

## SERIES A.

| Length in Feet. | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|
| 18 | 20 | 22 | 24 | 26 | 28 | 30 | Inches. | Lbs. per Ft. |
| 128 | 124 | 120 | 116 | 112 | 108 | 104 | ¼ | 11.25 |
| 141 | 137 | 133 | 128 | 124 | 120 | 115 | 5/16 | " |
| 154 | 150 | 146 | 141 | 136 | 131 | 126 | 3/8 | " |
| 168 | 163 | 158 | 153 | 147 | 142 | 137 | 7/16 | " |
| 182 | 176 | 170 | 165 | 159 | 153 | 147 | ½ | " |
| 195 | 189 | 183 | 178 | 171 | 165 | 158 | 9/16 | " |
| 209 | 203 | 196 | 190 | 183 | 177 | 169 | 5/8 | " |
| 42 | 138 | 133 | 129 | 124 | 119 | 115 | ¼ | 13.75 |
| 55 | 151 | 146 | 141 | 136 | 131 | 126 | 5/16 | " |
| 69 | 164 | 159 | 153 | 148 | 142 | 137 | 3/8 | " |
| 82 | 177 | 171 | 166 | 160 | 153 | 148 | 7/16 | " |
| 96 | 190 | 184 | 178 | 172 | 164 | 159 | ½ | " |
| 09 | 203 | 196 | 190 | 183 | 176 | 170 | 9/16 | " |
| 23 | 216 | 209 | 203 | 195 | 187 | 181 | 5/8 | " |
| 57 | 152 | 147 | 142 | 137 | 131 | 126 | ¼ | 16.25 |
| 71 | 165 | 160 | 154 | 148 | 143 | 137 | 5/16 | " |
| 34 | 178 | 172 | 166 | 160 | 154 | 148 | 3/8 | " |
| 98 | 191 | 185 | 178 | 172 | 165 | 159 | 7/16 | " |
| 11 | 204 | 198 | 191 | 184 | 177 | 170 | ½ | " |
| 24 | 217 | 210 | 203 | 195 | 188 | 181 | 9/16 | " |
| 38 | 231 | 223 | 215 | 207 | 199 | 191 | 5/8 | " |
| 72 | 167 | 161 | 155 | 149 | 143 | 137 | ¼ | 18.75 |
| 85 | 180 | 174 | 167 | 160 | 154 | 148 | 5/16 | " |
| 99 | 193 | 186 | 180 | 173 | 166 | 160 | 3/8 | " |
| 12 | 206 | 199 | 192 | 185 | 178 | 171 | 7/16 | " |
| 26 | 219 | 211 | 204 | 196 | 189 | 181 | ½ | " |
| 39 | 232 | 224 | 216 | 208 | 200 | 192 | 9/16 | " |
| 53 | 245 | 236 | 228 | 220 | 211 | 203 | 5/8 | " |
| 87 | 181 | 174 | 168 | 162 | 155 | 148 | ¼ | 21.25 |
| 00 | 194 | 187 | 180 | 173 | 166 | 159 | 5/16 | " |
| 14 | 207 | 200 | 192 | 185 | 178 | 170 | 3/8 | " |
| 27 | 220 | 213 | 205 | 196 | 189 | 181 | 7/16 | " |
| 41 | 233 | 225 | 217 | 209 | 201 | 192 | ½ | " |
| 54 | 246 | 238 | 229 | 221 | 212 | 202 | 9/16 | " |
| 268 | 260 | 250 | 241 | 232 | 223 | 214 | 5/8 | " |

For detail dimensions see page 212.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 9″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**




## SERIES A.

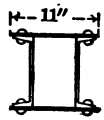
| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 6 | 8 | 10 | 12 | 14 | 16 |
| 13.25 | 1/4 | 45.2 | 13.28 | 3.34 | 164 | 162 | 160 | 158 | 155 | 152 |
| " | 5/16 | 49.9 | 14.66 | 3.32 | 181 | 179 | 177 | 174 | 171 | 168 |
| " | 3/8 | 54.6 | 16.03 | 3.31 | 198 | 196 | 193 | 191 | 187 | 183 |
| " | 7/16 | 59.2 | 17.40 | 3.30 | 215 | 213 | 210 | 207 | 203 | 199 |
| " | 1/2 | 63.9 | 18.78 | 3.29 | 232 | 229 | 227 | 223 | 219 | 214 |
| " | 9/16 | 68.5 | 20.16 | 3.28 | 249 | 246 | 243 | 239 | 235 | 230 |
| " | 5/8 | 73.3 | 21.53 | 3.28 | 266 | 263 | 260 | 255 | 251 | 246 |
| 15 | 1/4 | 48.7 | 14.32 | 3.29 | 177 | 175 | 173 | 170 | 167 | 163 |
| " | 5/16 | 53.4 | 15.70 | 3.28 | 194 | 192 | 189 | 186 | 183 | 179 |
| " | 3/8 | 58.1 | 17.07 | 3.28 | 211 | 209 | 206 | 202 | 199 | 195 |
| " | 7/16 | 62.7 | 18.44 | 3.27 | 228 | 225 | 222 | 219 | 215 | 210 |
| " | 1/2 | 67.4 | 19.82 | 3.26 | 245 | 242 | 239 | 235 | 231 | 226 |
| " | 9/16 | 72.0 | 21.20 | 3.26 | 262 | 259 | 255 | 251 | 247 | 242 |
| " | 5/8 | 76.8 | 22.57 | 3.25 | 279 | 275 | 272 | 267 | 263 | 257 |
| 20 | 1/4 | 58.7 | 17.26 | 3.19 | 213 | 210 | 208 | 204 | 200 | 196 |
| " | 5/16 | 63.4 | 18.64 | 3.19 | 230 | 227 | 224 | 220 | 216 | 212 |
| " | 3/8 | 68.1 | 20.01 | 3.19 | 247 | 244 | 241 | 236 | 232 | 227 |
| " | 7/16 | 72.7 | 21.38 | 3.19 | 263 | 261 | 257 | 253 | 248 | 243 |
| " | 1/2 | 77.4 | 22.76 | 3.19 | 280 | 278 | 274 | 269 | 264 | 259 |
| " | 9/16 | 82.0 | 24.14 | 3.19 | 297 | 294 | 291 | 285 | 280 | 274 |
| " | 5/8 | 86.8 | 25.51 | 3.18 | 314 | 311 | 307 | 301 | 296 | 290 |
| 25 | 1/4 | 68.7 | 20.20 | 3.10 | 249 | 246 | 243 | 238 | 234 | 228 |
| " | 5/16 | 73.4 | 21.58 | 3.11 | 266 | 263 | 259 | 254 | 250 | 244 |
| " | 3/8 | 78.1 | 22.95 | 3.11 | 283 | 279 | 276 | 270 | 265 | 260 |
| " | 7/16 | 82.7 | 24.32 | 3.12 | 300 | 296 | 292 | 287 | 281 | 275 |
| " | 1/2 | 87.4 | 25.70 | 3.12 | 317 | 313 | 309 | 304 | 297 | 291 |
| " | 9/16 | 92.0 | 27.08 | 3.12 | 334 | 330 | 325 | 320 | 313 | 307 |
| " | 5/8 | 96.8 | 28.45 | 3.12 | 351 | 346 | 342 | 336 | 329 | 322 |

For detail dimensions see page 292.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 9″ CHANNEL AND PLATE COLUMNS.

## SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**



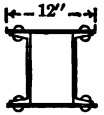

## SERIES A.

| Length in Feet. | | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | Inches. | Lbs. per Ft. |
| 149 | 145 | 141 | 137 | 134 | 129 | 125 | 121 | 117 | 1/4 | 13.25 |
| 164 | 160 | 156 | 152 | 147 | 143 | 138 | 134 | 129 | 5/16 | " |
| 179 | 175 | 171 | 165 | 160 | 155 | 150 | 146 | 141 | 3/8 | " |
| 194 | 189 | 184 | 179 | 174 | 169 | 163 | 158 | 153 | 7/16 | " |
| 209 | 204 | 199 | 194 | 188 | 182 | 176 | 171 | 165 | 1/2 | " |
| 225 | 219 | 214 | 208 | 202 | 195 | 189 | 182 | 176 | 9/16 | " |
| 240 | 234 | 228 | 222 | 215 | 209 | 202 | 194 | 188 | 5/8 | " |
| 160 | 156 | 152 | 148 | 143 | 139 | 134 | 130 | 126 | 1/4 | 15 |
| 175 | 171 | 166 | 162 | 157 | 152 | 147 | 142 | 137 | 5/16 | " |
| 190 | 186 | 181 | 176 | 171 | 166 | 160 | 154 | 149 | 3/8 | " |
| 206 | 201 | 195 | 190 | 184 | 178 | 172 | 167 | 161 | 7/16 | " |
| 221 | 216 | 210 | 203 | 197 | 191 | 185 | 179 | 173 | 1/2 | " |
| 236 | 231 | 225 | 217 | 211 | 204 | 198 | 191 | 185 | 9/16 | " |
| 252 | 245 | 238 | 231 | 225 | 218 | 211 | 204 | 196 | 5/8 | " |
| 192 | 186 | 181 | 176 | 170 | 165 | 159 | 154 | 148 | 1/4 | 20 |
| 207 | 201 | 196 | 190 | 184 | 178 | 172 | 166 | 160 | 5/16 | " |
| 222 | 216 | 210 | 204 | 197 | 191 | 185 | 179 | 172 | 3/8 | " |
| 237 | 231 | 224 | 218 | 211 | 204 | 197 | 191 | 183 | 7/16 | " |
| 253 | 246 | 239 | 232 | 224 | 217 | 210 | 203 | 195 | 1/2 | " |
| 268 | 260 | 253 | 246 | 238 | 230 | 223 | 216 | 207 | 9/16 | " |
| 282 | 275 | 268 | 260 | 251 | 243 | 236 | 226 | 219 | 5/8 | " |
| 223 | 216 | 210 | 204 | 197 | 191 | 183 | 177 | 170 | 1/4 | 25 |
| 238 | 232 | 224 | 218 | 210 | 204 | 197 | 189 | 183 | 5/16 | " |
| 253 | 246 | 239 | 232 | 224 | 217 | 210 | 201 | 194 | 3/8 | " |
| 268 | 261 | 253 | 246 | 238 | 230 | 222 | 213 | 206 | 7/16 | " |
| 283 | 276 | 267 | 260 | 252 | 243 | 235 | 226 | 218 | 1/2 | " |
| 298 | 291 | 282 | 274 | 265 | 256 | 247 | 238 | 229 | 9/16 | " |
| 313 | 306 | 296 | 287 | 279 | 269 | 260 | 250 | 241 | 5/8 | " |

*For detail dimensions see page 202.*

# SAFE LOADS IN THOUSANDS OF POUNDS
## 10″ CHANNEL AND PLATE COLUMNS
## SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. **Safety fact**



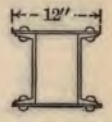

## SERIES A.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Fee | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 6 | 8 | 10 | 12 | 1 |
| 15 | ¼ | 50.4 | 14.92 | 3.62 | 184 | 183 | 181 | 179 | 17 |
| " | 5/16 | 55.5 | 16.42 | 3.61 | 203 | 201 | 199 | 197 | 19 |
| " | 3/8 | 60.6 | 17.92 | 3.59 | 221 | 220 | 217 | 215 | 21 |
| " | 7/16 | 65.7 | 19.42 | 3.58 | 240 | 238 | 235 | 232 | 22 |
| " | 1/2 | 70.8 | 20.92 | 3.58 | 259 | 257 | 254 | 250 | 24 |
| " | 9/16 | 75.9 | 22.42 | 3.57 | 277 | 275 | 272 | 268 | 26 |
| " | 5/8 | 81.0 | 23.92 | 3.56 | 296 | 293 | 290 | 286 | 28 |
| 20 | ¼ | 60.4 | 17.76 | 3.52 | 219 | 217 | 215 | 212 | 20 |
| " | 5/16 | 65.5 | 19.26 | 3.52 | 238 | 236 | 233 | 230 | 22 |
| " | 3/8 | 70.6 | 20.76 | 3.51 | 257 | 254 | 252 | 248 | 24 |
| " | 7/16 | 75.7 | 22.26 | 3.51 | 275 | 272 | 270 | 266 | 26 |
| " | 1/2 | 80.8 | 23.76 | 3.51 | 294 | 291 | 288 | 284 | 27 |
| " | 9/16 | 85.9 | 25.26 | 3.50 | 312 | 309 | 305 | 302 | 29 |
| " | 5/8 | 91.0 | 26.76 | 3.50 | 331 | 328 | 324 | 320 | 31 |
| 25 | ¼ | 70.4 | 20.70 | 3.42 | 255 | 253 | 250 | 247 | 24 |
| " | 5/16 | 75.5 | 22.20 | 3.43 | 274 | 272 | 268 | 265 | 26 |
| " | 3/8 | 80.6 | 23.70 | 3.43 | 293 | 290 | 287 | 282 | 27 |
| " | 7/16 | 85.7 | 25.20 | 3.43 | 311 | 308 | 305 | 300 | 29 |
| " | 1/2 | 90.8 | 26.70 | 3.43 | 330 | 327 | 323 | 318 | 31 |
| " | 9/16 | 95.9 | 28.20 | 3.44 | 348 | 345 | 341 | 336 | 33 |
| " | 5/8 | 101.0 | 29.70 | 3.44 | 367 | 364 | 359 | 355 | 34 |
| 30 | ¼ | 80.4 | 23.64 | 3.33 | 292 | 289 | 285 | 281 | 27 |
| " | 5/16 | 85.5 | 25.14 | 3.34 | 310 | 307 | 303 | 299 | 29 |
| " | 3/8 | 90.6 | 26.64 | 3.35 | 329 | 325 | 321 | 317 | 31 |
| " | 7/16 | 95.7 | 28.14 | 3.36 | 347 | 344 | 340 | 334 | 32 |
| " | 1/2 | 100.8 | 29.64 | 3.36 | 366 | 362 | 358 | 352 | 34 |
| " | 9/16 | 105.9 | 31.14 | 3.37 | 384 | 380 | 376 | 370 | 36 |
| " | 5/8 | 111.0 | 32.64 | 3.37 | 403 | 399 | 394 | 388 | 38 |
| 35 | ¼ | 90.4 | 26.58 | 3.26 | 328 | 324 | 320 | 315 | 30 |
| " | 5/16 | 95.5 | 28.08 | 3.27 | 347 | 343 | 338 | 333 | 32 |
| " | 3/8 | 100.6 | 29.58 | 3.28 | 365 | 361 | 357 | 351 | 34 |
| " | 7/16 | 105.7 | 31.08 | 3.29 | 384 | 380 | 375 | 369 | 36 |
| " | 1/2 | 110.8 | 32.58 | 3.29 | 402 | 398 | 393 | 387 | 37 |
| " | 9/16 | 115.9 | 34.08 | 3.30 | 421 | 416 | 411 | 405 | 39 |
| " | 5/8 | 121.0 | 35.58 | 3.31 | 439 | 435 | 429 | 423 | 41 |

For detail dimensions see page 208.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 10″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**



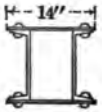

## SERIES A.

| Length in Feet. | | | | | | | | | | Thickness of Plate. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | Inches. | Lbs. per Ft. |
| 170 | 166 | 162 | 159 | 154 | 151 | 146 | 142 | 138 | 134 | 1/4 | 15 |
| 187 | 183 | 179 | 175 | 170 | 165 | 161 | 156 | 152 | 147 | 5/16 | " |
| 204 | 199 | 195 | 190 | 186 | 180 | 175 | 170 | 165 | 160 | 3/8 | " |
| 221 | 216 | 211 | 206 | 200 | 195 | 189 | 184 | 178 | 172 | 7/16 | " |
| 238 | 232 | 228 | 222 | 216 | 210 | 204 | 199 | 192 | 186 | 1/2 | " |
| 256 | 249 | 243 | 238 | 231 | 225 | 219 | 212 | 206 | 199 | 9/16 | " |
| 271 | 266 | 259 | 253 | 246 | 239 | 233 | 226 | 218 | 212 | 5/8 | " |
| 201 | 196 | 192 | 187 | 182 | 177 | 172 | 167 | 161 | 157 | 1/4 | 20 |
| 218 | 213 | 208 | 203 | 197 | 192 | 187 | 181 | 175 | 170 | 5/16 | " |
| 235 | 230 | 224 | 219 | 213 | 207 | 201 | 195 | 189 | 182 | 3/8 | " |
| 252 | 246 | 240 | 235 | 228 | 222 | 216 | 209 | 202 | 195 | 7/16 | " |
| 269 | 263 | 256 | 251 | 244 | 236 | 230 | 223 | 216 | 209 | 1/2 | " |
| 286 | 279 | 272 | 265 | 259 | 251 | 244 | 237 | 229 | 222 | 9/16 | " |
| 303 | 296 | 289 | 281 | 274 | 266 | 258 | 251 | 243 | 235 | 5/8 | " |
| | 228 | 222 | 216 | 210 | 204 | 198 | 191 | 186 | 180 | 1/4 | 25 |
| | 245 | 238 | 232 | 225 | 219 | 213 | 206 | 199 | 193 | 5/16 | " |
| | 261 | 255 | 248 | 241 | 233 | 227 | 220 | 213 | 206 | 3/8 | " |
| | 278 | 271 | 263 | 256 | 248 | 242 | 234 | 226 | 219 | 7/16 | " |
| | 294 | 287 | 279 | 271 | 263 | 256 | 248 | 240 | 232 | 1/2 | " |
| | 311 | 303 | 295 | 286 | 279 | 271 | 262 | 253 | 245 | 9/16 | " |
| | 327 | 319 | 310 | 302 | 294 | 285 | 276 | 267 | 258 | 5/8 | " |
| | | 252 | 245 | 238 | 230 | 223 | 216 | 209 | 201 | 1/4 | 30 |
| | 258 | 268 | 260 | 253 | 245 | 237 | 230 | 222 | 214 | 5/16 | " |
| | 275 | 284 | 276 | 268 | 260 | 252 | 243 | 237 | 228 | 3/8 | " |
| | 291 | 301 | 293 | 284 | 276 | 267 | 258 | 250 | 241 | 7/16 | " |
| | 307 | 317 | 308 | 299 | 290 | 281 | 272 | 263 | 254 | 1/2 | " |
| | 324 | 333 | 324 | 315 | 305 | 296 | 286 | 276 | 267 | 9/16 | " |
| | 342 | 349 | 339 | 330 | 320 | 310 | 300 | 290 | 280 | 5/8 | " |
| | 358 | | | | | | | | | | |
| | 289 | 282 | 273 | 265 | 256 | 248 | 240 | 232 | 224 | 1/4 | 35 |
| | 306 | 298 | 289 | 279 | 271 | 262 | 254 | 245 | 237 | 5/16 | " |
| | 322 | 313 | 305 | 296 | 287 | 278 | 267 | 258 | 249 | 3/8 | " |
| | 338 | 329 | 320 | 311 | 301 | 292 | 282 | 273 | 263 | 7/16 | " |
| | 354 | 345 | 336 | 326 | 316 | 306 | 296 | 286 | 276 | 1/2 | " |
| | 371 | 361 | 351 | 341 | 330 | 320 | 310 | 299 | 289 | 9/16 | " |
| | 389 | 379 | 367 | 356 | 345 | 334 | 323 | 312 | 301 | 5/8 | " |

*For detail dimensions see page 293.*

# SAFE LOADS IN THOUSANDS OF POUNDS
## 12″ CHANNEL AND PLATE COLUMNS.
## SQUARE ENDS.

**Based on Gordon's Formula** $P=\dfrac{50\,000}{1+\dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor**



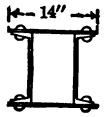

## SERIES A.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 8 | 10 | 12 | 14 | 16 | 18 | 2 |
| 20.5 | ¼ | 64.8 | 19.06 | 4.41 | 235 | 233 | 232 | 229 | 227 | 223 | 2 |
| " | 5/16 | 70.8 | 20.81 | 4.38 | 257 | 255 | 253 | 250 | 247 | 244 | 2 |
| " | 3/8 | 76.7 | 22.56 | 4.36 | 278 | 276 | 273 | 271 | 267 | 264 | 2 |
| " | 7/16 | 82.7 | 24.31 | 4.34 | 300 | 298 | 295 | 292 | 288 | 285 | 2 |
| " | ½ | 88.6 | 26.06 | 4.32 | 321 | 319 | 316 | 313 | 309 | 304 | 3 |
| " | 9/16 | 94.6 | 27.81 | 4.30 | 343 | 340 | 337 | 333 | 330 | 325 | 3 |
| " | 5/8 | 100.5 | 29.56 | 4.28 | 364 | 362 | 358 | 354 | 350 | 345 | 3 |
| 25 | ¼ | 73.8 | 21.70 | 4.35 | 268 | 266 | 263 | 261 | 257 | 254 | 2 |
| " | 5/16 | 79.8 | 23.45 | 4.32 | 289 | 287 | 284 | 282 | 278 | 274 | 2 |
| " | 3/8 | 85.7 | 25.20 | 4.31 | 311 | 308 | 305 | 303 | 299 | 294 | 2 |
| " | 7/16 | 91.7 | 26.95 | 4.29 | 332 | 330 | 327 | 323 | 319 | 315 | 3 |
| " | ½ | 97.6 | 28.70 | 4.27 | 354 | 351 | 348 | 344 | 340 | 335 | 3 |
| " | 9/16 | 103.6 | 30.45 | 4.26 | 375 | 373 | 369 | 365 | 360 | 356 | 3 |
| " | 5/8 | 109.5 | 32.20 | 4.25 | 397 | 393 | 390 | 386 | 381 | 376 | 3 |
| 30 | ¼ | 83.8 | 24.64 | 4.27 | 304 | 302 | 299 | 295 | 292 | 288 | 2 |
| " | 5/16 | 89.8 | 26.39 | 4.26 | 325 | 323 | 320 | 316 | 312 | 308 | 3 |
| " | 3/8 | 95.7 | 28.14 | 4.25 | 347 | 344 | 341 | 337 | 333 | 329 | 3 |
| " | 7/16 | 101.7 | 29.89 | 4.23 | 368 | 365 | 362 | 358 | 353 | 348 | 3 |
| " | ½ | 107.6 | 31.64 | 4.22 | 390 | 387 | 383 | 379 | 374 | 368 | 3 |
| " | 9/16 | 113.6 | 33.39 | 4.21 | 411 | 408 | 404 | 400 | 395 | 389 | 3 |
| " | 5/8 | 119.5 | 35.14 | 4.21 | 433 | 429 | 425 | 421 | 415 | 409 | 4 |
| 35 | ¼ | 93.8 | 27.58 | 4.19 | 340 | 337 | 334 | 330 | 326 | 321 | 3 |
| " | 5/16 | 99.8 | 29.33 | 4.18 | 361 | 358 | 355 | 351 | 347 | 341 | 3 |
| " | 3/8 | 105.7 | 31.08 | 4.18 | 383 | 380 | 376 | 372 | 367 | 362 | 3 |
| " | 7/16 | 111.7 | 32.83 | 4.17 | 405 | 401 | 397 | 392 | 388 | 382 | 3 |
| " | ½ | 117.6 | 34.58 | 4.16 | 426 | 422 | 418 | 413 | 409 | 402 | 3 |
| " | 9/16 | 123.6 | 36.33 | 4.16 | 448 | 444 | 439 | 434 | 429 | 423 | 4 |
| " | 5/8 | 129.5 | 38.08 | 4.15 | 469 | 465 | 461 | 455 | 449 | 443 | 4 |
| 40 | ¼ | 103.8 | 30.52 | 4.13 | 376 | 373 | 369 | 365 | 360 | 354 | 3 |
| " | 5/16 | 109.8 | 32.27 | 4.12 | 398 | 394 | 390 | 386 | 380 | 374 | 3 |
| " | 3/8 | 115.7 | 34.02 | 4.12 | 419 | 416 | 411 | 406 | 401 | 395 | 3 |
| " | 7/16 | 121.7 | 35.77 | 4.12 | 441 | 437 | 433 | 427 | 421 | 415 | 4 |
| " | ½ | 127.6 | 37.52 | 4.11 | 462 | 458 | 454 | 448 | 442 | 435 | 4 |
| " | 9/16 | 133.6 | 39.27 | 4.11 | 484 | 480 | 475 | 469 | 463 | 456 | 4 |
| " | 5/8 | 139.5 | 41.02 | 4.11 | 505 | 501 | 496 | 490 | 483 | 476 | 4 |

For detail dimensions see page 228.

# E LOADS IN THOUSANDS OF POUNDS FOR 12″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

sed on Gordon's Formula $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. Safety factor 4.



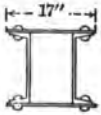

## SERIES A.

| Length in Feet. | | | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | Inches. | Lbs. per Ft. |
| 9 | 206 | 201 | 196 | 193 | 188 | 184 | 179 | 175 | 170 | ¼ | 20.5 |
| 8 | 223 | 220 | 214 | 209 | 205 | 200 | 195 | 190 | 186 | 5/16 | " |
| 6 | 242 | 237 | 232 | 227 | 221 | 216 | 211 | 206 | 200 | 3/8 | " |
| 6 | 260 | 255 | 249 | 244 | 238 | 232 | 227 | 223 | 216 | 7/16 | " |
| 5 | 279 | 274 | 267 | 261 | 255 | 249 | 242 | 237 | 230 | ½ | " |
| 4 | 297 | 291 | 285 | 278 | 271 | 265 | 258 | 251 | 245 | 9/16 | " |
| 2 | 316 | 309 | 302 | 296 | 288 | 281 | 274 | 267 | 259 | 5/8 | " |
| 7 | 233 | 228 | 223 | 218 | 213 | 208 | 203 | 197 | 193 | ¼ | 25 |
| 6 | 251 | 246 | 240 | 235 | 230 | 224 | 218 | 213 | 207 | 5/16 | " |
| 5 | 269 | 263 | 258 | 252 | 246 | 241 | 234 | 229 | 222 | 3/8 | " |
| 3 | 288 | 282 | 275 | 270 | 263 | 256 | 250 | 243 | 237 | 7/16 | " |
| 2 | 306 | 300 | 293 | 286 | 280 | 272 | 265 | 259 | 252 | ½ | " |
| 1 | 324 | 318 | 311 | 303 | 295 | 289 | 281 | 273 | 267 | 9/16 | " |
| 0 | 343 | 335 | 329 | 320 | 312 | 306 | 297 | 289 | 281 | 5/8 | " |
| 8 | 262 | 257 | 251 | 245 | 240 | 234 | 228 | 223 | 216 | ¼ | 30 |
| 7 | 281 | 276 | 269 | 263 | 256 | 250 | 244 | 237 | 232 | 5/16 | " |
| 6 | 300 | 293 | 287 | 280 | 273 | 267 | 260 | 253 | 246 | 3/8 | " |
| 5 | 318 | 311 | 304 | 297 | 290 | 282 | 275 | 268 | 261 | 7/16 | " |
| 3 | 337 | 329 | 321 | 313 | 307 | 299 | 291 | 282 | 276 | ½ | " |
| 2 | 354 | 347 | 339 | 331 | 322 | 315 | 307 | 298 | 290 | 9/16 | " |
| 1 | 372 | 365 | 357 | 348 | 339 | 332 | 323 | 314 | 305 | 5/8 | " |
| 9 | 292 | 286 | 280 | 273 | 266 | 259 | 253 | 246 | 239 | ¼ | 35 |
| 8 | 311 | 304 | 296 | 290 | 283 | 275 | 268 | 262 | 254 | 5/16 | " |
| 7 | 329 | 322 | 314 | 308 | 300 | 292 | 284 | 277 | 270 | 3/8 | " |
| 6 | 348 | 340 | 332 | 323 | 317 | 308 | 300 | 291 | 283 | 7/16 | " |
| 5 | 366 | 358 | 349 | 341 | 332 | 325 | 316 | 307 | 298 | ½ | " |
| 4 | 385 | 376 | 367 | 358 | 349 | 341 | 332 | 323 | 313 | 9/16 | " |
| 1 | 404 | 394 | 385 | 375 | 365 | 356 | 348 | 338 | 328 | 5/8 | " |
| 9 | 322 | 314 | 308 | 301 | 293 | 285 | 277 | 269 | 262 | ¼ | 40 |
| 8 | 340 | 333 | 324 | 316 | 310 | 301 | 293 | 285 | 277 | 5/16 | " |
| 7 | 359 | 351 | 342 | 333 | 326 | 318 | 309 | 300 | 292 | 3/8 | " |
| 6 | 377 | 369 | 360 | 351 | 343 | 334 | 325 | 316 | 307 | 7/16 | " |
| 5 | 396 | 387 | 377 | 368 | 358 | 350 | 341 | 331 | 322 | ½ | " |
| 4 | 412 | 405 | 395 | 385 | 375 | 367 | 357 | 347 | 337 | 9/16 | " |
| 2 | 433 | 423 | 412 | 402 | 391 | 383 | 373 | 362 | 352 | 5/8 | " |

*For detail dimensions see page 208.*

# SAFE LOADS IN THOUSANDS OF POUNDS
## 15″ CHANNEL AND PLATE COLUMNS
## SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$ **Safety fact**



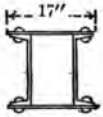

## SERIES A.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Fee | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| 33 | 3/8 | 109.4 | 32.55 | 5.41 | 399 | 396 | 393 | 390 | 386 | 381 | 37 |
| " | 1/2 | 116.6 | 34.68 | 5.38 | 425 | 422 | 418 | 415 | 411 | 406 | 401 |
| " | 1/2 | 123.8 | 36.80 | 5.36 | 451 | 448 | 444 | 440 | 436 | 431 | 426 |
| " | 5/8 | 131.0 | 38.92 | 5.33 | 476 | 474 | 470 | 465 | 460 | 456 | 450 |
| " | 5/8 | 138.2 | 41.05 | 5.31 | 502 | 500 | 495 | 490 | 485 | 481 | 475 |
| " | 3/4 | 145.4 | 43.18 | 5.29 | 529 | 525 | 521 | 516 | 510 | 504 | 499 |
| " | 3/4 | 152.7 | 45.30 | 5.24 | 555 | 550 | 545 | 541 | 535 | 529 | 522 |
| 35 | 3/8 | 113.4 | 33.33 | 5.40 | 409 | 406 | 402 | 399 | 395 | 390 | 387 |
| " | 1/2 | 120.6 | 35.46 | 5.37 | 435 | 432 | 428 | 424 | 420 | 415 | 410 |
| " | 1/2 | 127.8 | 37.58 | 5.35 | 461 | 457 | 453 | 449 | 445 | 440 | 435 |
| " | 5/8 | 135.0 | 39.70 | 5.32 | 486 | 483 | 479 | 474 | 469 | 465 | 459 |
| " | 5/8 | 142.2 | 41.83 | 5.30 | 512 | 509 | 505 | 500 | 494 | 488 | 484 |
| " | 3/4 | 149.4 | 43.96 | 5.28 | 538 | 534 | 530 | 525 | 520 | 513 | 508 |
| " | 3/4 | 156.7 | 46.08 | 5.27 | 564 | 560 | 556 | 551 | 545 | 538 | 531 |
| 40 | 3/8 | 123.4 | 36.27 | 5.35 | 445 | 441 | 438 | 433 | 430 | 425 | 419 |
| " | 1/2 | 130.6 | 38.40 | 5.33 | 470 | 467 | 463 | 459 | 454 | 450 | 444 |
| " | 1/2 | 137.8 | 40.52 | 5.31 | 496 | 493 | 489 | 484 | 479 | 475 | 469 |
| " | 5/8 | 145.0 | 42.64 | 5.29 | 522 | 519 | 514 | 509 | 504 | 498 | 493 |
| " | 5/8 | 152.2 | 44.77 | 5.27 | 548 | 544 | 540 | 535 | 529 | 523 | 516 |
| " | 3/4 | 159.4 | 46.90 | 5.26 | 574 | 570 | 566 | 560 | 554 | 548 | 540 |
| " | 3/4 | 166.7 | 49.02 | 5.24 | 600 | 595 | 590 | 586 | 579 | 572 | 565 |
| 45 | 3/8 | 133.4 | 39.23 | 5.31 | 480 | 477 | 473 | 469 | 464 | 459 | 454 |
| " | 1/2 | 140.6 | 41.36 | 5.29 | 506 | 503 | 499 | 494 | 489 | 483 | 478 |
| " | 1/2 | 147.8 | 43.48 | 5.27 | 532 | 528 | 525 | 519 | 514 | 508 | 501 |
| " | 5/8 | 155.0 | 45.60 | 5.25 | 558 | 554 | 550 | 545 | 539 | 532 | 525 |
| " | 5/8 | 162.2 | 47.73 | 5.24 | 584 | 580 | 575 | 570 | 564 | 557 | 550 |
| " | 3/4 | 169.4 | 49.86 | 5.23 | 610 | 606 | 600 | 596 | 589 | 582 | 575 |
| " | 3/4 | 176.7 | 51.98 | 2.21 | 636 | 631 | 626 | 619 | 614 | 607 | 599 |
| 50 | 3/8 | 143.4 | 42.17 | 5.26 | 516 | 512 | 509 | 504 | 498 | 492 | 486 |
| " | 1/2 | 150.6 | 44.30 | 5.24 | 542 | 538 | 533 | 529 | 524 | 517 | 511 |
| " | 1/2 | 157.8 | 46.42 | 5.23 | 568 | 564 | 559 | 555 | 549 | 542 | 535 |
| " | 5/8 | 165.0 | 48.54 | 5.21 | 594 | 590 | 584 | 578 | 574 | 567 | 559 |
| " | 5/8 | 172.2 | 50.67 | 5.20 | 620 | 615 | 610 | 604 | 599 | 592 | 584 |
| " | 3/4 | 179.4 | 52.80 | 5.19 | 646 | 641 | 636 | 629 | 622 | 616 | 608 |
| " | 3/4 | 186.7 | 54.92 | 5.18 | 672 | 667 | 661 | 654 | 647 | 641 | 633 |
| 55 | 3/8 | 153.4 | 45.11 | 5.21 | 552 | 548 | 543 | 538 | 533 | 527 | 520 |
| " | 1/2 | 160.6 | 47.24 | 5.19 | 578 | 574 | 569 | 563 | 557 | 552 | 544 |
| " | 1/2 | 167.8 | 49.36 | 5.18 | 604 | 600 | 594 | 588 | 582 | 576 | 569 |
| " | 5/8 | 175.0 | 51.48 | 5.17 | 630 | 625 | 620 | 613 | 607 | 599 | 593 |
| " | 5/8 | 182.2 | 53.61 | 5.16 | 656 | 651 | 645 | 639 | 632 | 624 | 616 |
| " | 3/4 | 189.4 | 55.74 | 5.15 | 682 | 677 | 671 | 664 | 657 | 649 | 640 |
| " | 3/4 | 196.7 | 57.86 | 5.14 | 708 | 703 | 696 | 689 | 682 | 673 | 665 |

For detail dimensions see page 233.

# LOADS IN THOUSANDS OF POUNDS FOR 17" CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

l on Gordon's Formula $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$ Safety factor 4.



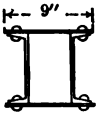

## SERIES A.

| Length in Feet. | | | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | Inches. | Lbs. per Ft. |
| 51 | 345 | 340 | 334 | 327 | 322 | 316 | 309 | 304 | 297 | 3/8 | 33 |
| 74 | 368 | 361 | 356 | 349 | 342 | 335 | 329 | 322 | 315 | 7/16 | " |
| 97 | 390 | 383 | 376 | 370 | 362 | 355 | 347 | 342 | 334 | 1/2 | " |
| 18 | 411 | 405 | 397 | 389 | 381 | 375 | 367 | 359 | 351 | 9/16 | " |
| 41 | 433 | 425 | 419 | 411 | 402 | 394 | 388 | 379 | 371 | 5/8 | " |
| 64 | 456 | 447 | 438 | 432 | 423 | 414 | 405 | 397 | 390 | 11/16 | " |
| 84 | 476 | 467 | 460 | 451 | 442 | 432 | 423 | 416 | 407 | 3/4 | " |
| 60 | 353 | 348 | 342 | 335 | 330 | 323 | 316 | 310 | 304 | 3/8 | 35 |
| 83 | 376 | 369 | 364 | 357 | 349 | 342 | 337 | 329 | 322 | 7/16 | " |
| 04 | 398 | 391 | 383 | 376 | 370 | 362 | 355 | 349 | 341 | 1/2 | " |
| 26 | 419 | 413 | 405 | 397 | 389 | 383 | 375 | 367 | 359 | 9/16 | " |
| 49 | 441 | 433 | 427 | 418 | 410 | 401 | 393 | 386 | 378 | 5/8 | " |
| 72 | 464 | 455 | 446 | 437 | 431 | 422 | 413 | 404 | 397 | 11/16 | " |
| 93 | 486 | 477 | 468 | 459 | 452 | 442 | 433 | 423 | 414 | 3/4 | " |
| 90 | 384 | 377 | 370 | 363 | 357 | 350 | 342 | 337 | 329 | 3/8 | 40 |
| 12 | 405 | 399 | 392 | 384 | 376 | 370 | 363 | 355 | 347 | 7/16 | " |
| 35 | 427 | 420 | 413 | 405 | 397 | 389 | 383 | 374 | 366 | 1/2 | " |
| 58 | 450 | 441 | 433 | 427 | 418 | 409 | 400 | 392 | 385 | 9/16 | " |
| 79 | 472 | 464 | 455 | 446 | 439 | 430 | 420 | 411 | 402 | 5/8 | " |
| 02 | 495 | 486 | 476 | 467 | 457 | 450 | 440 | 431 | 421 | 11/16 | " |
| 24 | 515 | 505 | 498 | 488 | 478 | 468 | 458 | 450 | 440 | 3/4 | " |
| 21 | 414 | 406 | 400 | 392 | 384 | 376 | 370 | 362 | 354 | 3/8 | 45 |
| 44 | 436 | 428 | 420 | 414 | 405 | 397 | 388 | 380 | 374 | 7/16 | " |
| 65 | 459 | 450 | 441 | 433 | 426 | 417 | 408 | 399 | 390 | 1/2 | " |
| 88 | 479 | 472 | 463 | 454 | 445 | 435 | 428 | 419 | 409 | 9/16 | " |
| 10 | 501 | 492 | 485 | 475 | 465 | 456 | 446 | 438 | 429 | 5/8 | " |
| 33 | 523 | 514 | 506 | 496 | 486 | 476 | 465 | 455 | 448 | 11/16 | " |
| 56 | 546 | 536 | 525 | 515 | 507 | 496 | 485 | 475 | 464 | 3/4 | " |
| 51 | 445 | 437 | 428 | 420 | 411 | 405 | 396 | 387 | 379 | 3/8 | 50 |
| 74 | 465 | 456 | 450 | 441 | 432 | 423 | 414 | 407 | 398 | 7/16 | " |
| 96 | 487 | 478 | 471 | 462 | 453 | 443 | 433 | 424 | 417 | 1/2 | " |
| 19 | 510 | 500 | 490 | 481 | 473 | 463 | 453 | 443 | 433 | 9/16 | " |
| 42 | 532 | 522 | 512 | 502 | 491 | 484 | 473 | 463 | 452 | 5/8 | " |
| 62 | 554 | 544 | 533 | 523 | 512 | 501 | 493 | 482 | 471 | 11/16 | " |
| 85 | 574 | 566 | 555 | 544 | 533 | 521 | 510 | 499 | 490 | 3/4 | " |
| 82 | 474 | 465 | 456 | 447 | 440 | 431 | 421 | 412 | 403 | 3/8 | 55 |
| 03 | 496 | 487 | 477 | 468 | 458 | 448 | 441 | 431 | 422 | 7/16 | " |
| 25 | 516 | 509 | 499 | 489 | 479 | 469 | 458 | 448 | 441 | 1/2 | " |
| 48 | 538 | 528 | 520 | 510 | 499 | 489 | 478 | 468 | 457 | 9/16 | " |
| 71 | 560 | 550 | 539 | 531 | 520 | 509 | 498 | 487 | 476 | 5/8 | " |
| 93 | 582 | 572 | 560 | 549 | 541 | 529 | 518 | 506 | 495 | 11/16 | " |
| 16 | 605 | 593 | 582 | 570 | 558 | 549 | 537 | 525 | 514 | 3/4 | " |

*For detail dimensions see page 233.*

# SAFE LOADS IN THOUSANDS OF POUNDS 6″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factc**



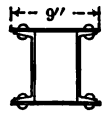

## SERIES B.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Fe | | | |
|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 4 | 6 | 8 | 1( |
| 8 | ¼ | 31.3 | 9.26 | 2.74 | 115 | 114 | 112 | 11 |
| " | 5/16 | 35.1 | 10.39 | 2.78 | 129 | 127 | 126 | 12 |
| " | 3/8 | 39.0 | 11.51 | 2.71 | 142 | 141 | 139 | 13 |
| " | 7/16 | 42.8 | 12.64 | 2.70 | 156 | 155 | 153 | 15 |
| " | ½ | 46.6 | 13.76 | 2.70 | 170 | 169 | 166 | 16 |
| " | 9/16 | 50.4 | 14.89 | 2.69 | 184 | 183 | 180 | 17 |
| " | 5/8 | 54.3 | 16.01 | 2.68 | 198 | 196 | 193 | 19 |
| 10.5 | ¼ | 36.3 | 10.68 | 2.68 | 132 | 131 | 129 | 12 |
| " | 5/16 | 40.1 | 11.81 | 2.67 | 146 | 145 | 142 | 14 |
| " | 3/8 | 44.0 | 12.93 | 2.66 | 160 | 158 | 156 | 15 |
| " | 7/16 | 47.8 | 14.06 | 2.66 | 174 | 172 | 170 | 16 |
| " | ½ | 51.6 | 15.18 | 2.65 | 188 | 186 | 183 | 17 |
| " | 9/16 | 55.4 | 16.31 | 2.65 | 202 | 200 | 197 | 19 |
| " | 5/8 | 59.3 | 17.43 | 2.65 | 216 | 213 | 210 | 20 |
| 13 | ¼ | 41.3 | 12.14 | 2.54 | 150 | 148 | 146 | 14 |
| " | 5/16 | 45.1 | 13.27 | 2.62 | 164 | 162 | 160 | 15 |
| " | 3/8 | 49.0 | 14.39 | 2.62 | 178 | 176 | 173 | 17 |
| " | 7/16 | 52.8 | 15.52 | 2.62 | 192 | 190 | 187 | 18 |
| " | ½ | 56.6 | 16.64 | 2.61 | 206 | 204 | 200 | 19 |
| " | 9/16 | 60.4 | 17.77 | 2.61 | 220 | 218 | 214 | 21 |
| " | 5/8 | 64.3 | 18.89 | 2.61 | 234 | 231 | 227 | 22 |
| 15.5 | ¼ | 46.3 | 13.62 | 2.47 | 169 | 166 | 164 | 16 |
| " | 5/16 | 50.1 | 14.75 | 2.54 | 183 | 180 | 178 | 17 |
| " | 3/8 | 54.0 | 15.87 | 2.57 | 196 | 194 | 191 | 18 |
| " | 7/16 | 57.8 | 17.00 | 2.57 | 210 | 208 | 205 | 20 |
| " | ½ | 61.6 | 18.12 | 2.57 | 224 | 222 | 218 | 21 |
| " | 9/16 | 65.4 | 19.25 | 2.57 | 238 | 236 | 232 | 22 |
| " | 5/8 | 69.3 | 20.37 | 2.57 | 252 | 249 | 245 | 24 |

For detail dimensions see page 204.

# AFE LOADS IN THOUSANDS OF POUNDS FOR 6″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**



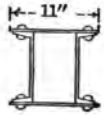

## SERIES B.

| Length in Feet. | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|
| 16 | 18 | 20 | 22 | 24 | 26 | 28 | Inches. | Lbs. per Ft. |
| 102 | 99 | 95 | 92 | 88 | 85 | 82 | 1/4 | 8 |
| 114 | 111 | 107 | 103 | 99 | 95 | 91 | 5/16 | " |
| 126 | 123 | 118 | 114 | 109 | 105 | 101 | 3/8 | " |
| 139 | 134 | 130 | 125 | 120 | 115 | 110 | 7/16 | " |
| 151 | 146 | 141 | 136 | 131 | 126 | 120 | 1/2 | " |
| 163 | 158 | 153 | 147 | 141 | 135 | 130 | 9/16 | " |
| 175 | 170 | 163 | 158 | 151 | 145 | 140 | 5/8 | " |
| 116 | 113 | 108 | 105 | 100 | 96 | 92 | 1/4 | 10.5 |
| 129 | 125 | 121 | 116 | 111 | 107 | 102 | 5/16 | " |
| 141 | 136 | 132 | 127 | 122 | 117 | 112 | 3/8 | " |
| 154 | 148 | 143 | 138 | 133 | 127 | 122 | 7/16 | " |
| 166 | 160 | 155 | 149 | 143 | 137 | 131 | 1/2 | " |
| 178 | 172 | 166 | 160 | 153 | 147 | 141 | 9/16 | " |
| 190 | 184 | 178 | 171 | 164 | 157 | 151 | 5/8 | " |
| 131 | 126 | 121 | 116 | 112 | 107 | 102 | 1/4 | 13 |
| 144 | 139 | 135 | 129 | 124 | 119 | 114 | 5/16 | " |
| 157 | 151 | 146 | 134 | 134 | 129 | 123 | 3/8 | " |
| 169 | 163 | 158 | 151 | 145 | 139 | 133 | 7/16 | " |
| 181 | 175 | 168 | 162 | 155 | 149 | 143 | 1/2 | " |
| 193 | 187 | 180 | 173 | 166 | 159 | 152 | 9/16 | " |
| 206 | 198 | 191 | 184 | 176 | 169 | 162 | 5/8 | " |
| 146 | 140 | 135 | 129 | 124 | 118 | 113 | 1/4 | 15.5 |
| 159 | 153 | 148 | 142 | 136 | 130 | 124 | 5/16 | " |
| 172 | 166 | 160 | 153 | 147 | 141 | 134 | 3/8 | " |
| 184 | 178 | 171 | 164 | 158 | 151 | 144 | 7/16 | " |
| 196 | 189 | 182 | 175 | 168 | 161 | 154 | 1/2 | " |
| 209 | 201 | 194 | 186 | 179 | 171 | 163 | 9/16 | " |
| 221 | 213 | 205 | 196 | 189 | 181 | 173 | 5/8 | " |

*For detail dimensions see page 204.*

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 7″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**



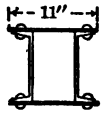

## SERIES B.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 6 | 8 | 10 | 12 | 14 | 16 |
| 9.75 | 1/4 | 38.2 | 11.20 | 3.20 | 138 | 137 | 135 | 132 | 130 | 127 |
| " | 5/16 | 42.9 | 12.58 | 3.27 | 155 | 154 | 151 | 149 | 146 | 143 |
| " | 3/8 | 47.6 | 13.95 | 3.33 | 172 | 170 | 168 | 166 | 163 | 160 |
| " | 7/16 | 52.2 | 15.32 | 3.35 | 189 | 187 | 185 | 182 | 179 | 175 |
| " | 1/2 | 56.9 | 16.70 | 3.34 | 206 | 204 | 202 | 198 | 195 | 191 |
| " | 9/16 | 61.5 | 18.08 | 3.33 | 223 | 221 | 218 | 215 | 211 | 207 |
| " | 5/8 | 66.3 | 19.45 | 3.32 | 240 | 238 | 235 | 231 | 227 | 223 |
| 12.25 | 1/4 | 43.2 | 12.70 | 3.08 | 156 | 155 | 153 | 150 | 147 | 143 |
| " | 5/16 | 47.9 | 14.08 | 3.16 | 173 | 172 | 169 | 166 | 163 | 159 |
| " | 3/8 | 52.6 | 15.45 | 3.22 | 190 | 188 | 186 | 183 | 180 | 176 |
| " | 7/16 | 57.2 | 16.82 | 3.29 | 208 | 206 | 203 | 200 | 196 | 192 |
| " | 1/2 | 61.9 | 18.20 | 3.31 | 225 | 222 | 220 | 216 | 213 | 208 |
| " | 9/16 | 66.5 | 19.58 | 3.30 | 242 | 239 | 236 | 233 | 229 | 224 |
| " | 5/8 | 71.3 | 20.95 | 3.29 | 259 | 256 | 253 | 249 | 244 | 239 |
| 14.75 | 1/4 | 48.2 | 14.18 | 2.99 | 174 | 172 | 170 | 167 | 163 | 159 |
| " | 5/16 | 52.9 | 15.56 | 3.07 | 191 | 189 | 186 | 183 | 179 | 176 |
| " | 3/8 | 57.6 | 16.93 | 3.14 | 209 | 206 | 203 | 200 | 196 | 192 |
| " | 7/16 | 62.2 | 18.30 | 3.20 | 225 | 223 | 220 | 216 | 212 | 208 |
| " | 1/2 | 66.9 | 19.68 | 3.26 | 243 | 240 | 237 | 233 | 229 | 224 |
| " | 9/16 | 71.5 | 21.06 | 3.27 | 260 | 257 | 253 | 250 | 245 | 240 |
| " | 5/8 | 76.3 | 22.43 | 3.27 | 277 | 274 | 270 | 266 | 261 | 256 |
| 17.25 | 1/4 | 53.2 | 15.64 | 2.91 | 192 | 190 | 187 | 183 | 179 | 174 |
| " | 5/16 | 57.9 | 17.02 | 2.99 | 209 | 207 | 204 | 200 | 195 | 191 |
| " | 3/8 | 62.6 | 18.39 | 3.06 | 226 | 224 | 220 | 217 | 212 | 207 |
| " | 7/16 | 67.2 | 19.76 | 3.13 | 243 | 240 | 237 | 234 | 228 | 224 |
| " | 1/2 | 71.9 | 21.14 | 3.19 | 260 | 258 | 254 | 250 | 245 | 240 |
| " | 9/16 | 76.5 | 22.52 | 3.24 | 277 | 275 | 271 | 267 | 262 | 257 |
| " | 5/8 | 81.3 | 23.89 | 3.24 | 294 | 291 | 288 | 283 | 278 | 272 |
| 19.75 | 1/4 | 58.2 | 17.12 | 2.85 | 210 | 207 | 204 | 200 | 195 | 190 |
| " | 5/16 | 62.9 | 18.50 | 2.93 | 228 | 225 | 221 | 217 | 212 | 206 |
| " | 3/8 | 67.6 | 19.87 | 3.00 | 244 | 241 | 238 | 233 | 228 | 223 |
| " | 7/16 | 72.2 | 21.24 | 3.07 | 261 | 259 | 254 | 250 | 245 | 240 |
| " | 1/2 | 76.9 | 22.62 | 3.13 | 279 | 275 | 272 | 267 | 262 | 256 |
| " | 9/16 | 81.5 | 24.00 | 3.19 | 296 | 293 | 289 | 284 | 278 | 273 |
| " | 5/8 | 86.3 | 25.37 | 3.21 | 313 | 309 | 305 | 301 | 294 | 288 |

For detail dimensions see page 234.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 7″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**



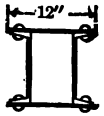

## SERIES B.

| Length in Feet. | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | Inches. | Lbs. per Ft. |
| 121 | 118 | 114 | 111 | 107 | 103 | 100 | 97 | 1/4 | 9.75 |
| 137 | 133 | 130 | 125 | 121 | 117 | 114 | 110 | 5/16 | " |
| 152 | 148 | 144 | 140 | 136 | 132 | 127 | 123 | 3/8 | " |
| 167 | 163 | 159 | 154 | 149 | 145 | 140 | 136 | 7/16 | " |
| 182 | 178 | 173 | 168 | 163 | 158 | 153 | 147 | 1/2 | " |
| 198 | 192 | 187 | 182 | 176 | 171 | 165 | 160 | 9/16 | " |
| 213 | 207 | 201 | 196 | 190 | 184 | 178 | 172 | 5/8 | " |
| 136 | 132 | 128 | 124 | 119 | 115 | 111 | 107 | 1/4 | 12.25 |
| 152 | 147 | 143 | 139 | 134 | 129 | 125 | 120 | 5/16 | " |
| 167 | 163 | 158 | 153 | 148 | 143 | 139 | 133 | 3/8 | " |
| 183 | 178 | 173 | 168 | 163 | 158 | 153 | 148 | 7/16 | " |
| 199 | 194 | 188 | 182 | 176 | 171 | 165 | 160 | 1/2 | " |
| 213 | 207 | 202 | 196 | 190 | 184 | 178 | 172 | 9/16 | " |
| 228 | 222 | 216 | 210 | 203 | 197 | 190 | 184 | 5/8 | " |
| 150 | 145 | 141 | 136 | 131 | 127 | 122 | 117 | 1/4 | 14.75 |
| 166 | 161 | 156 | 151 | 146 | 141 | 136 | 130 | 5/16 | " |
| 182 | 177 | 172 | 166 | 161 | 155 | 149 | 144 | 3/8 | " |
| 198 | 192 | 187 | 181 | 175 | 169 | 163 | 158 | 7/16 | " |
| 214 | 209 | 202 | 196 | 190 | 184 | 178 | 172 | 1/2 | " |
| 229 | 223 | 217 | 210 | 203 | 197 | 190 | 184 | 9/16 | " |
| 244 | 238 | 231 | 223 | 216 | 209 | 203 | 196 | 5/8 | " |
| 164 | 159 | 154 | 148 | 143 | 137 | 132 | 128 | 1/4 | 17.25 |
| 180 | 175 | 169 | 163 | 157 | 152 | 146 | 140 | 5/16 | " |
| 197 | 190 | 185 | 178 | 172 | 166 | 160 | 154 | 3/8 | " |
| 212 | 206 | 200 | 194 | 188 | 180 | 174 | 167 | 7/16 | " |
| 228 | 222 | 216 | 208 | 202 | 195 | 189 | 181 | 1/2 | " |
| 244 | 238 | 231 | 224 | 217 | 209 | 202 | 195 | 9/16 | " |
| 259 | 252 | 245 | 238 | 230 | 222 | 215 | 207 | 5/8 | " |
| 179 | 173 | 167 | 161 | 155 | 149 | 143 | 137 | 1/4 | 19.75 |
| 195 | 189 | 182 | 176 | 169 | 163 | 157 | 150 | 5/16 | " |
| 211 | 205 | 198 | 191 | 185 | 177 | 170 | 164 | 3/8 | " |
| 227 | 220 | 214 | 206 | 199 | 192 | 185 | 178 | 7/16 | " |
| 243 | 236 | 229 | 222 | 215 | 207 | 200 | 192 | 1/2 | " |
| 259 | 252 | 245 | 236 | 229 | 222 | 214 | 206 | 9/16 | " |
| 275 | 266 | 259 | 251 | 243 | 236 | 227 | 219 | 5/8 | " |

*For detail dimensions see page 204.*

# SAFE LOADS IN THOUSANDS OF POUNDS F
## 8″ CHANNEL AND PLATE COLUMNS.
## SQUARE ENDS.

**Based on Gordon's Formula** $P=\dfrac{50\,000}{1+\dfrac{(12\,L)^2}{36\,000\,r^2}}$ **. Safety factor 4.**



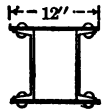

## SERIES B.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 6 | 8 | 10 | 12 | 14 | 16 |
| 11.25 | ¼ | 42.9 | 12.70 | 3.62 | 157 | 156 | 154 | 152 | 150 | 14 |
| " | 5/16 | 48.0 | 14.20 | 3.70 | 176 | 174 | 172 | 171 | 168 | 16 |
| " | 3/8 | 53.1 | 15.70 | 3.72 | 194 | 193 | 191 | 189 | 186 | 18 |
| " | 7/16 | 58.2 | 17.20 | 3.70 | 213 | 211 | 209 | 207 | 203 | 20 |
| " | ½ | 63.3 | 18.70 | 3.68 | 231 | 229 | 227 | 224 | 221 | 21 |
| " | 9/16 | 68.4 | 20.20 | 3.66 | 250 | 248 | 245 | 242 | 239 | 23 |
| " | 5/8 | 73.5 | 21.70 | 3.65 | 268 | 266 | 264 | 260 | 256 | 25 |
| 13.75 | ¼ | 47.9 | 14.08 | 3.52 | 174 | 172 | 171 | 168 | 165 | 16 |
| " | 5/16 | 53.0 | 15.58 | 3.60 | 193 | 191 | 189 | 187 | 184 | 18 |
| " | 3/8 | 58.1 | 17.08 | 3.67 | 211 | 209 | 207 | 205 | 202 | 19 |
| " | 7/16 | 63.2 | 18.58 | 3.67 | 230 | 228 | 226 | 223 | 220 | 21 |
| " | ½ | 68.3 | 20.08 | 3.66 | 248 | 246 | 244 | 241 | 237 | 23 |
| " | 9/16 | 73.4 | 21.58 | 3.64 | 267 | 265 | 262 | 258 | 255 | 25 |
| " | 5/8 | 78.5 | 23.08 | 3.63 | 285 | 283 | 280 | 276 | 272 | 26 |
| 16.25 | ¼ | 52.9 | 15.56 | 3.42 | 192 | 190 | 188 | 185 | 182 | 17 |
| " | 5/16 | 58.0 | 17.06 | 3.50 | 211 | 209 | 206 | 204 | 200 | 19 |
| " | 3/8 | 63.1 | 18.56 | 3.58 | 229 | 228 | 225 | 222 | 219 | 21 |
| " | 7/16 | 68.2 | 20.06 | 3.64 | 248 | 246 | 244 | 240 | 237 | 23 |
| " | ½ | 73.3 | 21.56 | 3.63 | 266 | 264 | 261 | 258 | 254 | 25 |
| " | 9/16 | 78.4 | 23.06 | 3.62 | 285 | 283 | 279 | 276 | 272 | 26 |
| " | 5/8 | 83.5 | 24.56 | 3.61 | 303 | 301 | 298 | 294 | 289 | 28 |
| 18.75 | ¼ | 57.9 | 17.02 | 3.34 | 210 | 208 | 205 | 202 | 199 | 19 |
| " | 5/16 | 63.0 | 18.52 | 3.42 | 229 | 227 | 224 | 221 | 217 | 21 |
| " | 3/8 | 68.1 | 20.02 | 3.50 | 247 | 245 | 242 | 239 | 235 | 23 |
| " | 7/16 | 73.2 | 21.52 | 3.57 | 266 | 264 | 261 | 257 | 254 | 24 |
| " | ½ | 78.3 | 23.02 | 3.61 | 284 | 282 | 279 | 276 | 271 | 26 |
| " | 9/16 | 83.4 | 24.52 | 3.60 | 303 | 301 | 297 | 294 | 289 | 28 |
| " | 5/8 | 88.5 | 26.02 | 3.59 | 322 | 319 | 315 | 312 | 307 | 30 |
| 21.25 | ¼ | 62.9 | 18.50 | 3.27 | 228 | 226 | 223 | 219 | 215 | 21 |
| " | 5/16 | 68.0 | 20.00 | 3.36 | 247 | 244 | 241 | 238 | 234 | 23 |
| " | 3/8 | 73.1 | 21.50 | 3.43 | 266 | 263 | 260 | 256 | 252 | 24 |
| " | 7/16 | 78.2 | 23.00 | 3.51 | 284 | 282 | 279 | 275 | 270 | 26 |
| " | ½ | 83.3 | 24.50 | 3.57 | 303 | 300 | 297 | 293 | 289 | 28 |
| " | 9/16 | 88.4 | 26.00 | 3.57 | 321 | 319 | 315 | 311 | 306 | 30 |
| " | 5/8 | 93.5 | 27.50 | 3.57 | 340 | 337 | 333 | 329 | 324 | 31 |

For detail dimensions see page 294.

# E LOADS IN THOUSANDS OF POUNDS FOR 8″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

ısed on Gordon's Formula $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. Safety factor 4.



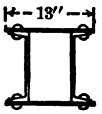

## SERIES B.

| Length in Feet. | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|
| 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | Inches. | Lbs. per Ft. |
| 135 | 131 | 128 | 124 | 121 | 117 | 114 | 110 | ¼ | 11.25 |
| 152 | 148 | 144 | 141 | 137 | 133 | 129 | 125 | 5/16 | " |
| 168 | 164 | 160 | 155 | 151 | 147 | 143 | 139 | 3/8 | " |
| 184 | 180 | 175 | 170 | 166 | 161 | 156 | 151 | 7/16 | " |
| 200 | 194 | 190 | 184 | 179 | 175 | 169 | 164 | ½ | " |
| 215 | 210 | 204 | 199 | 194 | 188 | 182 | 176 | 9/16 | " |
| 231 | 226 | 219 | 214 | 207 | 202 | 195 | 189 | 5/8 | " |
| 149 | 144 | 140 | 137 | 132 | 128 | 124 | 120 | ¼ | 13.75 |
| 165 | 161 | 157 | 153 | 148 | 144 | 139 | 134 | 5/16 | " |
| 183 | 178 | 173 | 168 | 164 | 159 | 154 | 149 | 3/8 | " |
| 199 | 193 | 187 | 183 | 178 | 173 | 168 | 162 | 7/16 | " |
| 214 | 209 | 203 | 198 | 193 | 186 | 181 | 175 | ½ | " |
| 230 | 224 | 218 | 213 | 206 | 200 | 194 | 188 | 9/16 | " |
| 246 | 239 | 233 | 226 | 220 | 213 | 207 | 200 | 5/8 | " |
| 163 | 158 | 153 | 149 | 144 | 140 | 135 | 130 | ¼ | 16.25 |
| 179 | 175 | 170 | 165 | 160 | 155 | 150 | 145 | 5/16 | " |
| 197 | 191 | 187 | 181 | 176 | 170 | 165 | 160 | 3/8 | " |
| 214 | 209 | 203 | 198 | 191 | 186 | 180 | 175 | 7/16 | " |
| 230 | 223 | 218 | 211 | 206 | 199 | 194 | 187 | ½ | " |
| 245 | 239 | 233 | 226 | 220 | 213 | 207 | 200 | 9/16 | " |
| 261 | 254 | 247 | 241 | 233 | 227 | 219 | 213 | 5/8 | " |
| 176 | 171 | 166 | 161 | 155 | 150 | 145 | 140 | ¼ | 18.75 |
| 194 | 188 | 182 | 177 | 171 | 166 | 161 | 155 | 5/16 | " |
| 210 | 205 | 199 | 193 | 188 | 182 | 176 | 170 | 3/8 | " |
| 228 | 222 | 216 | 210 | 203 | 198 | 191 | 186 | 7/16 | " |
| 245 | 238 | 231 | 226 | 219 | 213 | 206 | 200 | ½ | " |
| 260 | 254 | 247 | 240 | 233 | 226 | 219 | 212 | 9/16 | " |
| 276 | 269 | 262 | 254 | 247 | 239 | 232 | 224 | 5/8 | " |
| 191 | 184 | 178 | 173 | 167 | 161 | 156 | 150 | ¼ | 21.25 |
| 208 | 202 | 196 | 190 | 184 | 178 | 172 | 165 | 5/16 | " |
| 225 | 218 | 212 | 206 | 200 | 193 | 187 | 180 | 3/8 | " |
| 243 | 236 | 229 | 223 | 216 | 209 | 202 | 196 | 7/16 | " |
| 260 | 252 | 246 | 239 | 231 | 225 | 218 | 211 | ½ | " |
| 276 | 268 | 261 | 253 | 245 | 239 | 231 | 224 | 9/16 | " |
| 291 | 283 | 276 | 268 | 260 | 253 | 244 | 237 | 5/8 | " |

*For detail dimensions see page 204.*

# SAFE LOADS IN THOUSANDS OF POUNDS
## 9″ CHANNEL AND PLATE COLUMNS.
## SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor**



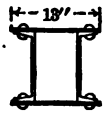

## SERIES B.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 6 | 8 | 10 | 12 | 14 | 16 |
| 13.25 | ¼ | 48.6 | 14.28 | 4.05 | 177 | 176 | 174 | 172 | 170 | 168 |
| " | 5/16 | 54.1 | 15.90 | 4.10 | 197 | 196 | 194 | 192 | 190 | 187 |
| " | 3/8 | 59.7 | 17.53 | 4.07 | 217 | 216 | 214 | 212 | 209 | 207 |
| " | 7/16 | 65.2 | 19.16 | 4.04 | 237 | 236 | 234 | 231 | 228 | 225 |
| " | ½ | 70.7 | 20.78 | 4.02 | 257 | 256 | 253 | 251 | 248 | 244 |
| " | 9/16 | 76.2 | 22.40 | 4.00 | 277 | 276 | 273 | 270 | 267 | 263 |
| " | 5/8 | 81.7 | 24.03 | 3.99 | 297 | 296 | 293 | 290 | 286 | 282 |
| 15.0 | ¼ | 52.1 | 15.32 | 3.97 | 190 | 188 | 187 | 185 | 183 | 180 |
| " | 5/16 | 57.6 | 16.94 | 4.05 | 210 | 208 | 207 | 204 | 202 | 199 |
| " | 3/8 | 63.2 | 18.57 | 4.05 | 230 | 228 | 226 | 224 | 221 | 218 |
| " | 7/16 | 68.7 | 20.20 | 4.03 | 250 | 249 | 246 | 244 | 241 | 237 |
| " | ½ | 74.2 | 21.82 | 4.01 | 270 | 268 | 266 | 263 | 260 | 256 |
| " | 9/16 | 79.7 | 23.44 | 3.99 | 290 | 288 | 286 | 283 | 279 | 275 |
| " | 5/8 | 85.2 | 25.07 | 3.97 | 310 | 308 | 306 | 302 | 299 | 295 |
| 20.0 | ¼ | 62.1 | 18.26 | 3.78 | 226 | 224 | 222 | 219 | 216 | 213 |
| " | 5/16 | 67.6 | 19.88 | 3.87 | 246 | 244 | 242 | 239 | 236 | 233 |
| " | 3/8 | 73.2 | 21.51 | 3.95 | 266 | 264 | 262 | 260 | 256 | 252 |
| " | 7/16 | 78.7 | 23.14 | 3.98 | 286 | 285 | 282 | 279 | 276 | 272 |
| " | ½ | 84.2 | 24.76 | 3.96 | 306 | 305 | 302 | 299 | 295 | 291 |
| " | 9/16 | 89.7 | 26.39 | 3.95 | 327 | 325 | 322 | 318 | 314 | 309 |
| " | 5/8 | 95.2 | 28.01 | 3.94 | 347 | 345 | 342 | 338 | 333 | 328 |
| 25.0 | ¼ | 72.1 | 21.20 | 3.64 | 262 | 260 | 257 | 254 | 251 | 246 |
| " | 5/16 | 77.6 | 22.82 | 3.73 | 282 | 280 | 277 | 274 | 270 | 266 |
| " | 3/8 | 83.2 | 24.45 | 3.81 | 303 | 300 | 298 | 294 | 290 | 285 |
| " | 7/16 | 88.7 | 26.08 | 3.89 | 323 | 320 | 317 | 314 | 310 | 305 |
| " | ½ | 94.2 | 27.70 | 3.92 | 343 | 341 | 337 | 333 | 329 | 324 |
| " | 9/16 | 99.7 | 29.32 | 3.91 | 363 | 361 | 357 | 353 | 348 | 343 |
| " | 5/8 | 105.2 | 30.95 | 3.90 | 383 | 380 | 377 | 373 | 368 | 362 |

For detail dimensions see page 29A.

# 'E LOADS IN THOUSANDS OF POUNDS FOR 9″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

'ased on Gordon's Formula $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. Safety factor 4.



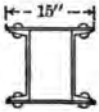

## SERIES B.

| Length in Feet. | | | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | Inches. | Lbs. per Ft. |
| 57 | 153 | 150 | 146 | 143 | 139 | 136 | 132 | 128 | 125 | ¼ | 13.25 |
| 74 | 172 | 168 | 164 | 160 | 156 | 152 | 148 | 144 | 140 | 5/16 | " |
| 92 | 188 | 184 | 180 | 175 | 171 | 167 | 163 | 158 | 154 | 3/8 | " |
| 10 | 206 | 201 | 196 | 192 | 187 | 182 | 177 | 172 | 167 | 7/16 | " |
| 27 | 222 | 217 | 212 | 207 | 202 | 196 | 191 | 186 | 181 | ½ | " |
| 45 | 240 | 234 | 229 | 223 | 217 | 211 | 206 | 200 | 194 | 9/16 | " |
| 63 | 257 | 251 | 245 | 239 | 233 | 227 | 221 | 215 | 208 | 5/8 | " |
| 67 | 164 | 159 | 156 | 152 | 148 | 144 | 140 | 136 | 132 | ¼ | 15.0 |
| 86 | 182 | 178 | 174 | 169 | 165 | 161 | 156 | 152 | 148 | 5/16 | " |
| 04 | 199 | 195 | 190 | 186 | 181 | 176 | 172 | 167 | 162 | 3/8 | " |
| 21 | 216 | 212 | 207 | 202 | 197 | 192 | 187 | 181 | 176 | 7/16 | " |
| 38 | 233 | 228 | 223 | 217 | 212 | 206 | 200 | 195 | 189 | ½ | " |
| 56 | 251 | 245 | 239 | 233 | 227 | 221 | 215 | 209 | 203 | 9/16 | " |
| 74 | 268 | 261 | 255 | 248 | 242 | 235 | 229 | 223 | 216 | 5/8 | " |
| 97 | 192 | 187 | 183 | 177 | 172 | 168 | 162 | 158 | 153 | ¼ | 20.0 |
| 15 | 211 | 206 | 200 | 195 | 190 | 185 | 180 | 174 | 168 | 5/16 | " |
| 34 | 229 | 224 | 218 | 213 | 207 | 202 | 196 | 191 | 186 | 3/8 | " |
| 53 | 247 | 242 | 236 | 230 | 224 | 218 | 213 | 205 | 200 | 7/16 | " |
| 69 | 264 | 258 | 251 | 245 | 239 | 232 | 226 | 220 | 214 | ½ | " |
| 87 | 281 | 274 | 268 | 261 | 255 | 248 | 241 | 234 | 228 | 9/16 | " |
| 05 | 298 | 291 | 284 | 277 | 270 | 263 | 256 | 247 | 240 | 5/8 | " |
| 26 | 221 | 214 | 209 | 202 | 197 | 190 | 185 | 179 | 173 | ¼ | 25.0 |
| 45 | 238 | 233 | 227 | 220 | 214 | 207 | 201 | 196 | 189 | 5/16 | " |
| 64 | 258 | 252 | 245 | 238 | 232 | 226 | 218 | 212 | 206 | 3/8 | " |
| 83 | 276 | 270 | 264 | 257 | 250 | 242 | 236 | 229 | 222 | 7/16 | " |
| 01 | 295 | 288 | 280 | 273 | 266 | 259 | 252 | 245 | 238 | ½ | " |
| 19 | 312 | 304 | 296 | 289 | 281 | 274 | 266 | 260 | 251 | 9/16 | " |
| 35 | 328 | 320 | 313 | 309 | 297 | 289 | 281 | 273 | 264 | 5/8 | " |

*For detail dimensions see page 204.*

# SAFE LOADS IN THOUSANDS OF POUNDS 10″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{50\,000}{1 + \dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor**



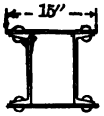

## SERIES B.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| 15 | 1/4 | 55.5 | 16.42 | 4.49 | 203 | 201 | 199 | 198 | 195 | 193 | 190 |
| " | 5/16 | 61.9 | 18.30 | 4.58 | 226 | 224 | 223 | 220 | 218 | 216 | 212 |
| " | 3/8 | 68.3 | 20.17 | 4.65 | 249 | 247 | 245 | 243 | 241 | 238 | 235 |
| " | 7/16 | 74.6 | 22.05 | 4.70 | 272 | 271 | 268 | 266 | 263 | 261 | 257 |
| " | 1/2 | 81.0 | 23.92 | 4.67 | 296 | 294 | 291 | 289 | 286 | 282 | 278 |
| " | 9/16 | 87.4 | 25.80 | 4.65 | 319 | 316 | 314 | 311 | 308 | 304 | 300 |
| " | 5/8 | 93.8 | 27.67 | 4.63 | 342 | 339 | 337 | 334 | 330 | 326 | 322 |
| 20 | 1/4 | 65.5 | 19.26 | 4.29 | 237 | 236 | 233 | 231 | 228 | 225 | 221 |
| " | 5/16 | 71.9 | 21.14 | 4.39 | 261 | 259 | 257 | 254 | 251 | 248 | 244 |
| " | 3/8 | 78.3 | 23.01 | 4.47 | 284 | 282 | 279 | 277 | 273 | 270 | 266 |
| " | 7/16 | 84.6 | 24.89 | 4.55 | 307 | 305 | 303 | 300 | 297 | 292 | 289 |
| " | 1/2 | 91.0 | 26.76 | 4.62 | 331 | 328 | 326 | 323 | 319 | 315 | 311 |
| " | 9/16 | 97.4 | 28.64 | 4.63 | 354 | 351 | 349 | 346 | 341 | 337 | 333 |
| " | 5/8 | 103.8 | 30.51 | 4.61 | 377 | 374 | 371 | 368 | 364 | 359 | 355 |
| 25 | 1/4 | 75.5 | 22.20 | 4.13 | 274 | 271 | 268 | 265 | 262 | 258 | 254 |
| " | 5/16 | 81.9 | 24.08 | 4.23 | 297 | 294 | 292 | 288 | 285 | 280 | 277 |
| " | 3/8 | 88.3 | 25.95 | 4.32 | 320 | 318 | 315 | 312 | 308 | 303 | 299 |
| " | 7/16 | 94.6 | 27.83 | 4.40 | 343 | 341 | 338 | 334 | 331 | 326 | 322 |
| " | 1/2 | 101.0 | 29.70 | 4.48 | 367 | 364 | 361 | 357 | 353 | 349 | 343 |
| " | 9/16 | 107.4 | 31.58 | 4.55 | 390 | 387 | 384 | 380 | 376 | 371 | 366 |
| " | 5/8 | 113.8 | 33.45 | 4.58 | 413 | 410 | 407 | 403 | 399 | 394 | 388 |
| 30 | 1/4 | 85.5 | 25.14 | 4.01 | 309 | 307 | 303 | 300 | 295 | 291 | 286 |
| " | 5/16 | 91.9 | 27.02 | 4.11 | 333 | 330 | 327 | 323 | 318 | 313 | 308 |
| " | 3/8 | 98.3 | 28.89 | 4.20 | 356 | 353 | 349 | 346 | 341 | 336 | 331 |
| " | 7/16 | 104.6 | 30.77 | 4.28 | 379 | 377 | 373 | 369 | 365 | 359 | 353 |
| " | 1/2 | 111.0 | 32.64 | 4.36 | 403 | 400 | 396 | 392 | 387 | 382 | 376 |
| " | 9/16 | 117.4 | 34.52 | 4.43 | 426 | 423 | 419 | 415 | 410 | 404 | 399 |
| " | 5/8 | 123.8 | 36.39 | 4.50 | 449 | 446 | 442 | 438 | 432 | 428 | 422 |
| 35 | 1/4 | 95.5 | 28.08 | 3.90 | 345 | 342 | 338 | 334 | 329 | 324 | 318 |
| " | 5/16 | 101.9 | 29.96 | 4.00 | 369 | 365 | 361 | 357 | 352 | 346 | 340 |
| " | 3/8 | 108.3 | 31.83 | 4.10 | 392 | 389 | 385 | 380 | 375 | 369 | 363 |
| " | 7/16 | 114.6 | 33.71 | 4.18 | 415 | 412 | 408 | 404 | 398 | 392 | 386 |
| " | 1/2 | 121.0 | 35.58 | 4.26 | 438 | 436 | 431 | 426 | 420 | 415 | 409 |
| " | 9/16 | 127.4 | 37.46 | 4.33 | 462 | 459 | 454 | 450 | 444 | 437 | 432 |
| " | 5/8 | 133.8 | 39.33 | 4.40 | 485 | 481 | 478 | 472 | 467 | 461 | 455 |

For detail dimensions see page 235.

# E LOADS IN THOUSANDS OF POUNDS FOR 10″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

ased on Gordon's Formula $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$. Safety factor 4.




## SERIES B.

| Length in Feet. | | | | | | | | | | | Thickness of Plates, | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | Inches. | Lbs. per Ft. |
| 78 | 174 | 171 | 167 | 163 | 159 | 156 | 152 | 148 | 145 | 141 | ¼ | 15 |
| 99 | 195 | 191 | 188 | 183 | 179 | 176 | 171 | 167 | 163 | 159 | 5/16 | " |
| 20 | 216 | 212 | 208 | 204 | 199 | 195 | 190 | 185 | 181 | 177 | 3/8 | " |
| 41 | 237 | 233 | 228 | 223 | 218 | 214 | 209 | 204 | 199 | 195 | 7/16 | " |
| 61 | 257 | 251 | 246 | 242 | 237 | 231 | 226 | 221 | 215 | 210 | ½ | " |
| 82 | 276 | 271 | 266 | 261 | 254 | 249 | 244 | 237 | 232 | 226 | 9/16 | " |
| 02 | 296 | 291 | 285 | 278 | 273 | 267 | 260 | 254 | 248 | 241 | 5/8 | " |
| 06 | 201 | 197 | 193 | 188 | 183 | 179 | 174 | 169 | 165 | 160 | ¼ | 20 |
| 27 | 223 | 218 | 214 | 208 | 203 | 198 | 193 | 189 | 183 | 179 | 5/16 | " |
| 48 | 244 | 238 | 234 | 228 | 223 | 218 | 213 | 208 | 202 | 197 | 3/8 | " |
| 70 | 265 | 260 | 254 | 249 | 243 | 238 | 232 | 226 | 221 | 216 | 7/16 | " |
| 91 | 286 | 281 | 274 | 269 | 264 | 257 | 251 | 246 | 239 | 233 | ½ | " |
| 13 | 306 | 301 | 295 | 288 | 282 | 276 | 269 | 263 | 257 | 250 | 9/16 | " |
| 32 | 326 | 320 | 313 | 307 | 301 | 293 | 286 | 280 | 272 | 266 | 5/8 | " |
| 34 | 229 | 224 | 219 | 213 | 207 | 202 | 196 | 190 | 186 | 180 | ¼ | 25 |
| 56 | 250 | 245 | 240 | 234 | 227 | 221 | 216 | 210 | 204 | 199 | 5/16 | " |
| 77 | 272 | 266 | 260 | 254 | 248 | 241 | 236 | 229 | 223 | 217 | 3/8 | " |
| 99 | 294 | 287 | 281 | 274 | 268 | 261 | 256 | 248 | 241 | 236 | 7/16 | " |
| 22 | 315 | 309 | 302 | 296 | 288 | 282 | 274 | 268 | 261 | 255 | ½ | " |
| 42 | 336 | 330 | 322 | 316 | 308 | 301 | 295 | 287 | 280 | 274 | 9/16 | " |
| 54 | 356 | 350 | 343 | 335 | 328 | 321 | 312 | 305 | 299 | 290 | 5/8 | " |
| 53 | 257 | 250 | 244 | 237 | 231 | 224 | 218 | 212 | 205 | 199 | ¼ | 30 |
| 85 | 278 | 272 | 265 | 258 | 252 | 245 | 239 | 232 | 225 | 218 | 5/16 | " |
| 06 | 300 | 293 | 286 | 279 | 273 | 265 | 258 | 251 | 243 | 238 | 3/8 | " |
| 29 | 322 | 314 | 308 | 300 | 292 | 286 | 278 | 270 | 264 | 256 | 7/16 | " |
| 51 | 342 | 336 | 328 | 320 | 313 | 305 | 298 | 290 | 282 | 275 | ½ | " |
| 72 | 364 | 357 | 349 | 342 | 333 | 326 | 317 | 310 | 301 | 294 | 9/16 | " |
| 94 | 386 | 378 | 370 | 362 | 355 | 345 | 338 | 329 | 321 | 312 | 5/8 | " |
| 91 | 284 | 277 | 269 | 262 | 255 | 248 | 239 | 232 | 225 | 219 | ¼ | 35 |
| 13 | 306 | 298 | 291 | 283 | 275 | 267 | 260 | 252 | 245 | 238 | 5/16 | " |
| 36 | 328 | 320 | 312 | 304 | 296 | 287 | 281 | 273 | 265 | 257 | 3/8 | " |
| 57 | 349 | 340 | 334 | 325 | 317 | 309 | 301 | 292 | 284 | 276 | 7/16 | " |
| 79 | 372 | 363 | 354 | 345 | 338 | 329 | 320 | 312 | 303 | 294 | ½ | " |
| 01 | 393 | 384 | 375 | 367 | 358 | 350 | 340 | 331 | 323 | 314 | 9/16 | " |
| 22 | 415 | 405 | 397 | 387 | 379 | 369 | 361 | 351 | 341 | 333 | 5/8 | " |

*For detail dimensions see page 205.*

# SAFE LOADS IN THOUSANDS OF POUNDS 12″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\,L)^2}{36\,000\,r^2}}$, **Safety factor**

## SERIES B.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet. | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
| 20.5 | ¼ | 68.2 | 20.06 | 5.23 | 248 | 247 | 246 | 244 | 241 | 240 | 237 |
| " | 5/16 | 75.0 | 22.06 | 5.18 | 273 | 272 | 270 | 268 | 266 | 263 | 260 |
| " | 3/8 | 81.8 | 24.06 | 5.14 | 298 | 296 | 295 | 292 | 290 | 287 | 283 |
| " | 7/16 | 88.6 | 26.06 | 5.10 | 322 | 321 | 318 | 317 | 314 | 311 | 307 |
| " | ½ | 95.4 | 28.06 | 5.07 | 347 | 345 | 343 | 340 | 337 | 333 | 331 |
| " | 9/16 | 102.2 | 30.06 | 5.04 | 372 | 370 | 367 | 364 | 361 | 357 | 354 |
| " | 5/8 | 109.0 | 32.06 | 5.01 | 397 | 394 | 392 | 389 | 385 | 381 | 377 |
| 25 | ¼ | 77.2 | 22.70 | 5.09 | 281 | 279 | 277 | 275 | 273 | 270 | 267 |
| " | 5/16 | 84.0 | 24.70 | 5.14 | 306 | 304 | 302 | 300 | 297 | 294 | 291 |
| " | 3/8 | 90.8 | 26.70 | 5.11 | 330 | 328 | 326 | 324 | 321 | 318 | 315 |
| " | 7/16 | 97.6 | 28.70 | 5.07 | 355 | 353 | 351 | 348 | 345 | 341 | 338 |
| " | ½ | 104.4 | 30.70 | 5.05 | 380 | 378 | 375 | 372 | 369 | 365 | 361 |
| " | 9/16 | 111.2 | 32.70 | 5.02 | 405 | 402 | 400 | 396 | 393 | 389 | 384 |
| " | 5/8 | 118.0 | 34.70 | 5.00 | 429 | 427 | 424 | 421 | 417 | 412 | 408 |
| 30 | ¼ | 87.2 | 25.64 | 4.93 | 317 | 315 | 313 | 311 | 308 | 304 | 300 |
| " | 5/16 | 94.0 | 27.64 | 5.04 | 342 | 340 | 338 | 335 | 332 | 328 | 326 |
| " | 3/8 | 100.8 | 29.64 | 5.07 | 367 | 365 | 362 | 359 | 356 | 352 | 349 |
| " | 7/16 | 107.6 | 31.64 | 5.04 | 391 | 389 | 387 | 383 | 380 | 376 | 373 |
| " | ½ | 114.4 | 33.64 | 5.02 | 416 | 414 | 411 | 408 | 404 | 400 | 395 |
| " | 9/16 | 121.2 | 35.64 | 4.99 | 441 | 438 | 435 | 432 | 428 | 424 | 419 |
| " | 5/8 | 128.0 | 37.64 | 4.98 | 466 | 463 | 460 | 456 | 452 | 447 | 442 |
| 35 | ¼ | 97.2 | 28.58 | 4.80 | 353 | 351 | 349 | 346 | 342 | 338 | 334 |
| " | 5/16 | 104.0 | 30.58 | 4.91 | 378 | 376 | 374 | 370 | 366 | 362 | 358 |
| " | 3/8 | 110.8 | 32.58 | 5.01 | 403 | 401 | 398 | 395 | 391 | 387 | 383 |
| " | 7/16 | 117.6 | 34.58 | 4.99 | 428 | 425 | 422 | 419 | 415 | 411 | 406 |
| " | ½ | 124.4 | 36.58 | 4.97 | 453 | 450 | 447 | 443 | 439 | 435 | 430 |
| " | 9/16 | 131.2 | 38.58 | 4.95 | 477 | 475 | 471 | 468 | 463 | 458 | 453 |
| " | 5/8 | 138.0 | 40.58 | 4.94 | 502 | 499 | 496 | 492 | 487 | 482 | 477 |
| 40 | ¼ | 107.2 | 31.52 | 4.69 | 389 | 387 | 384 | 380 | 377 | 373 | 367 |
| " | 5/16 | 114.0 | 33.52 | 4.80 | 414 | 412 | 409 | 405 | 402 | 396 | 391 |
| " | 3/8 | 120.8 | 35.52 | 4.90 | 439 | 437 | 434 | 430 | 425 | 421 | 416 |
| " | 7/16 | 127.6 | 37.52 | 4.95 | 464 | 462 | 458 | 455 | 451 | 446 | 441 |
| " | ½ | 134.4 | 39.52 | 4.94 | 489 | 486 | 483 | 479 | 474 | 470 | 464 |
| " | 9/16 | 141.2 | 41.52 | 4.92 | 514 | 511 | 507 | 503 | 497 | 492 | 486 |
| " | 5/8 | 148.0 | 43.52 | 4.91 | 538 | 535 | 532 | 526 | 521 | 516 | 510 |

For detail dimensions see page 235.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 12″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\dfrac{50\,000}{1+\dfrac{(12\,L)^2}{36\,000\,r^2}}$ **Safety factor 4.**

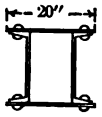
## SERIES B.

| Length in Feet. | | | | | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | Inches. | Lbs. per Ft. |
| 228 | 225 | 222 | 218 | 215 | 211 | 207 | 204 | 200 | 196 | 191 | 187 | ¼ | 20.5 |
| 251 | 247 | 243 | 239 | 235 | 231 | 227 | 223 | 218 | 214 | 209 | 205 | 5/16 | " |
| 272 | 269 | 265 | 261 | 256 | 251 | 247 | 242 | 237 | 232 | 228 | 223 | 3/8 | " |
| 295 | 291 | 286 | 281 | 276 | 271 | 266 | 262 | 257 | 251 | 246 | 241 | 7/16 | " |
| 318 | 313 | 308 | 303 | 297 | 292 | 286 | 281 | 275 | 269 | 263 | 258 | ½ | " |
| 339 | 334 | 328 | 324 | 319 | 313 | 307 | 301 | 295 | 288 | 282 | 276 | 9/16 | " |
| 362 | 356 | 350 | 344 | 338 | 332 | 326 | 319 | 313 | 306 | 299 | 293 | 5/8 | " |
| 257 | 253 | 249 | 245 | 241 | 236 | 232 | 227 | 222 | 219 | 214 | 210 | ¼ | 25 |
| 280 | 276 | 272 | 268 | 263 | 258 | 253 | 248 | 243 | 238 | 234 | 229 | 5/16 | " |
| 302 | 298 | 293 | 288 | 283 | 279 | 274 | 268 | 263 | 258 | 252 | 247 | 3/8 | " |
| 325 | 320 | 315 | 310 | 304 | 299 | 293 | 287 | 281 | 275 | 269 | 264 | 7/16 | " |
| 348 | 342 | 337 | 331 | 325 | 319 | 313 | 307 | 301 | 295 | 288 | 282 | ½ | " |
| 369 | 363 | 357 | 351 | 345 | 339 | 332 | 325 | 319 | 312 | 305 | 299 | 9/16 | " |
| 391 | 385 | 379 | 373 | 366 | 359 | 352 | 345 | 338 | 331 | 324 | 317 | 5/8 | " |
| 288 | 284 | 279 | 274 | 269 | 264 | 259 | 254 | 249 | 243 | 238 | 233 | ¼ | 30 |
| 312 | 307 | 302 | 298 | 293 | 287 | 282 | 276 | 271 | 265 | 260 | 254 | 5/16 | " |
| 336 | 330 | 325 | 320 | 314 | 308 | 302 | 296 | 290 | 284 | 278 | 272 | 3/8 | " |
| 357 | 351 | 346 | 341 | 335 | 329 | 323 | 316 | 310 | 304 | 297 | 291 | 7/16 | " |
| 379 | 374 | 368 | 361 | 355 | 348 | 342 | 335 | 328 | 321 | 314 | 307 | ½ | " |
| 402 | 396 | 389 | 383 | 376 | 369 | 362 | 355 | 347 | 340 | 333 | 326 | 9/16 | " |
| 425 | 418 | 411 | 404 | 397 | 390 | 382 | 375 | 367 | 359 | 351 | 344 | 5/8 | " |
| 320 | 315 | 310 | 303 | 297 | 292 | 286 | 280 | 273 | 267 | 261 | 255 | ¼ | 35 |
| 344 | 338 | 333 | 327 | 321 | 315 | 309 | 303 | 295 | 289 | 282 | 276 | 5/16 | " |
| 368 | 362 | 356 | 350 | 344 | 337 | 331 | 324 | 318 | 311 | 304 | 298 | 3/8 | " |
| 390 | 384 | 378 | 371 | 365 | 358 | 351 | 344 | 337 | 330 | 323 | 316 | 7/16 | " |
| 413 | 406 | 400 | 393 | 386 | 379 | 371 | 364 | 355 | 347 | 340 | 332 | ½ | " |
| 434 | 427 | 420 | 413 | 405 | 398 | 390 | 382 | 374 | 366 | 358 | 350 | 9/16 | " |
| 456 | 449 | 442 | 434 | 426 | 418 | 410 | 402 | 394 | 385 | 377 | 369 | 5/8 | " |
| 351 | 344 | 339 | 333 | 326 | 318 | 312 | 306 | 298 | 291 | 285 | 278 | ¼ | 40 |
| 375 | 369 | 363 | 355 | 349 | 342 | 335 | 328 | 320 | 313 | 306 | 299 | 5/16 | " |
| 399 | 393 | 386 | 380 | 373 | 366 | 357 | 350 | 343 | 335 | 328 | 321 | 3/8 | " |
| 422 | 415 | 408 | 401 | 394 | 387 | 379 | 372 | 364 | 356 | 348 | 341 | 7/16 | " |
| 444 | 437 | 430 | 423 | 415 | 407 | 399 | 391 | 383 | 375 | 367 | 359 | ½ | " |
| 466 | 459 | 452 | 444 | 436 | 428 | 420 | 411 | 403 | 394 | 386 | 375 | 9/16 | " |
| 489 | 481 | 473 | 465 | 457 | 448 | 440 | 431 | 420 | 411 | 402 | 393 | 5/8 | " |

*For detail dimensions see page 205.*

# SAFE LOADS IN THOUSANDS OF POUNDS 15″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\frac{50\,000}{1+\frac{(12\ L)^2}{36\,000\,r^2}}$. **Safety factor**



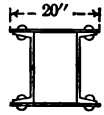

## SERIES B.

| Weight of each Channel. | Thickness of Plates. | Weight of Column. | Area of Column Section. | Least Radius of Gyration. | Length in Feet | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lbs. per Ft. | Inches. | Lbs. per Ft. | Sq. Ins. | Inches. | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| 33 | 3/8 | 117.0 | 34.80 | 6.59 | 429 | 427 | 425 | 423 | 420 | 417 | 414 |
| " | 7/16 | 125.5 | 37.30 | 6.57 | 460 | 458 | 456 | 453 | 450 | 447 | 442 |
| " | 1/2 | 134.0 | 39.80 | 6.52 | 491 | 489 | 485 | 482 | 479 | 476 | 472 |
| " | 9/16 | 142.5 | 42.30 | 6.48 | 521 | 519 | 516 | 513 | 509 | 505 | 501 |
| " | 5/8 | 151.0 | 44.80 | 6.44 | 552 | 549 | 546 | 543 | 539 | 535 | 531 |
| " | 11/16 | 159.5 | 47.30 | 6.41 | 583 | 580 | 577 | 573 | 569 | 565 | 561 |
| " | 3/4 | 168.0 | 49.80 | 6.38 | 614 | 611 | 607 | 604 | 599 | 595 | 589 |
| 35 | 3/8 | 121.0 | 35.58 | 6.55 | 439 | 437 | 435 | 432 | 428 | 425 | 422 |
| " | 7/16 | 129.5 | 38.08 | 6.56 | 470 | 468 | 465 | 463 | 459 | 455 | 451 |
| " | 1/2 | 138.0 | 40.58 | 6.52 | 501 | 498 | 495 | 492 | 488 | 485 | 481 |
| " | 9/16 | 146.5 | 43.08 | 6.48 | 531 | 528 | 525 | 522 | 519 | 515 | 511 |
| " | 5/8 | 155.0 | 45.58 | 6.44 | 562 | 559 | 556 | 552 | 549 | 545 | 540 |
| " | 11/16 | 163.5 | 48.08 | 6.41 | 592 | 590 | 586 | 583 | 579 | 574 | 570 |
| " | 3/4 | 172.0 | 50.58 | 6.38 | 623 | 620 | 617 | 613 | 609 | 604 | 598 |
| 40 | 3/8 | 131.0 | 38.52 | 6.41 | 475 | 472 | 470 | 467 | 464 | 460 | 457 |
| " | 7/16 | 139.5 | 41.02 | 6.51 | 506 | 503 | 500 | 497 | 494 | 490 | 486 |
| " | 1/2 | 148.0 | 43.52 | 6.50 | 537 | 534 | 531 | 527 | 524 | 520 | 516 |
| " | 9/16 | 156.5 | 46.02 | 6.47 | 567 | 564 | 561 | 558 | 554 | 550 | 545 |
| " | 5/8 | 165.0 | 48.52 | 6.43 | 598 | 595 | 592 | 588 | 584 | 580 | 575 |
| " | 11/16 | 173.5 | 51.02 | 6.40 | 629 | 626 | 622 | 618 | 614 | 610 | 603 |
| " | 3/4 | 182.0 | 53.52 | 6.37 | 659 | 656 | 653 | 649 | 644 | 638 | 633 |
| 45 | 3/8 | 141.0 | 41.48 | 6.28 | 511 | 509 | 506 | 502 | 498 | 494 | 490 |
| " | 7/16 | 149.5 | 43.98 | 6.39 | 542 | 539 | 536 | 533 | 529 | 525 | 520 |
| " | 1/2 | 158.0 | 46.48 | 6.48 | 573 | 570 | 567 | 563 | 559 | 555 | 551 |
| " | 9/16 | 166.5 | 48.98 | 6.45 | 604 | 601 | 597 | 594 | 590 | 585 | 580 |
| " | 5/8 | 175.0 | 51.48 | 6.42 | 634 | 631 | 628 | 624 | 620 | 615 | 610 |
| " | 11/16 | 183.5 | 53.98 | 6.39 | 665 | 662 | 658 | 654 | 650 | 645 | 638 |
| " | 3/4 | 192.0 | 56.48 | 6.37 | 696 | 693 | 689 | 685 | 680 | 673 | 667 |
| 50 | 3/8 | 151.0 | 44.42 | 6.17 | 547 | 544 | 541 | 537 | 533 | 528 | 523 |
| " | 7/16 | 159.5 | 46.92 | 6.28 | 578 | 575 | 572 | 567 | 563 | 559 | 555 |
| " | 1/2 | 168.0 | 49.42 | 6.37 | 609 | 606 | 603 | 599 | 595 | 589 | 584 |
| " | 9/16 | 176.5 | 51.92 | 6.43 | 640 | 636 | 633 | 629 | 625 | 620 | 615 |
| " | 5/8 | 185.0 | 54.42 | 6.40 | 671 | 667 | 664 | 660 | 655 | 650 | 643 |
| " | 11/16 | 193.5 | 56.92 | 6.37 | 701 | 698 | 694 | 690 | 685 | 678 | 673 |
| " | 3/4 | 202.0 | 59.42 | 6.35 | 732 | 729 | 725 | 720 | 715 | 708 | 702 |
| 55 | 3/8 | 161.0 | 47.36 | 6.07 | 583 | 580 | 576 | 571 | 567 | 563 | 556 |
| " | 7/16 | 169.5 | 49.86 | 6.18 | 614 | 610 | 607 | 603 | 599 | 593 | 588 |
| " | 1/2 | 178.0 | 52.36 | 6.28 | 645 | 642 | 639 | 633 | 629 | 624 | 619 |
| " | 9/16 | 186.5 | 54.86 | 6.37 | 676 | 673 | 669 | 665 | 660 | 654 | 648 |
| " | 5/8 | 195.0 | 57.36 | 6.38 | 707 | 703 | 700 | 695 | 690 | 685 | 678 |
| " | 11/16 | 203.5 | 59.86 | 6.35 | 738 | 734 | 730 | 726 | 721 | 713 | 707 |
| " | 3/4 | 212.0 | 62.36 | 6.33 | 768 | 764 | 760 | 756 | 751 | 743 | 737 |

For detail dimensions see page 206.

# SAFE LOADS IN THOUSANDS OF POUNDS FOR 15″ CHANNEL AND PLATE COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P=\dfrac{50\,000}{1+\dfrac{(12\,L)^2}{36\,000\,r^2}}$. **Safety factor 4.**




## SERIES B.

| Length in Feet. | | | | | | | | | | | | Thickness of Plates. | Weight of each Channel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | Inches. | Lbs. per Ft. |
| 401 | 397 | 393 | 388 | 383 | 379 | 374 | 369 | 364 | 359 | 353 | 348 | 3/8 | 33 |
| 430 | 425 | 421 | 416 | 411 | 406 | 401 | 395 | 390 | 384 | 379 | 373 | 7/16 | " |
| 459 | 454 | 449 | 444 | 439 | 433 | 427 | 422 | 414 | 408 | 402 | 396 | 1/2 | " |
| 487 | 482 | 477 | 470 | 464 | 458 | 452 | 446 | 440 | 434 | 427 | 421 | 9/16 | " |
| 515 | 509 | 503 | 498 | 492 | 485 | 479 | 473 | 466 | 457 | 450 | 444 | 5/8 | " |
| 543 | 538 | 532 | 525 | 519 | 512 | 504 | 497 | 490 | 483 | 476 | 468 | 11/16 | " |
| 572 | 566 | 560 | 553 | 544 | 537 | 530 | 523 | 516 | 508 | 501 | 491 | 3/4 | " |
| 410 | 406 | 401 | 397 | 392 | 387 | 382 | 377 | 372 | 367 | 361 | 356 | 3/8 | 35 |
| 439 | 434 | 430 | 425 | 420 | 414 | 409 | 404 | 398 | 392 | 387 | 381 | 7/16 | " |
| 468 | 463 | 458 | 452 | 447 | 442 | 436 | 430 | 422 | 416 | 410 | 404 | 1/2 | " |
| 496 | 491 | 486 | 478 | 473 | 467 | 461 | 454 | 448 | 442 | 435 | 429 | 9/16 | " |
| 523 | 518 | 512 | 506 | 500 | 494 | 487 | 481 | 474 | 465 | 458 | 451 | 5/8 | " |
| 552 | 546 | 540 | 534 | 528 | 521 | 512 | 505 | 498 | 491 | 483 | 476 | 11/16 | " |
| 581 | 575 | 568 | 562 | 553 | 546 | 538 | 531 | 524 | 516 | 509 | 498 | 3/4 | " |
| 442 | 438 | 433 | 428 | 423 | 417 | 410 | 404 | 399 | 393 | 387 | 381 | 3/8 | 40 |
| 473 | 468 | 463 | 457 | 452 | 446 | 439 | 433 | 427 | 421 | 414 | 408 | 7/16 | " |
| 502 | 496 | 491 | 485 | 480 | 471 | 465 | 459 | 453 | 446 | 440 | 433 | 1/2 | " |
| 530 | 525 | 517 | 511 | 505 | 499 | 492 | 485 | 479 | 472 | 465 | 458 | 9/16 | " |
| 557 | 551 | 545 | 539 | 532 | 526 | 519 | 512 | 502 | 495 | 488 | 480 | 5/8 | " |
| 586 | 580 | 573 | 567 | 560 | 553 | 543 | 536 | 528 | 521 | 513 | 505 | 11/16 | " |
| 615 | 608 | 601 | 592 | 585 | 577 | 570 | 562 | 554 | 546 | 538 | 527 | 3/4 | " |
| 475 | 470 | 464 | 459 | 451 | 445 | 440 | 433 | 427 | 421 | 413 | 407 | 3/8 | 45 |
| 505 | 500 | 494 | 488 | 483 | 474 | 468 | 462 | 455 | 449 | 442 | 435 | 7/16 | " |
| 536 | 530 | 524 | 516 | 510 | 504 | 497 | 490 | 483 | 477 | 470 | 463 | 1/2 | " |
| 563 | 557 | 550 | 544 | 537 | 531 | 524 | 517 | 509 | 502 | 492 | 485 | 9/16 | " |
| 591 | 585 | 578 | 572 | 565 | 558 | 550 | 540 | 533 | 525 | 518 | 510 | 5/8 | " |
| 620 | 613 | 607 | 600 | 592 | 582 | 575 | 567 | 559 | 551 | 543 | 535 | 11/16 | " |
| 649 | 642 | 635 | 625 | 517 | 609 | 601 | 593 | 585 | 576 | 568 | 556 | 3/4 | " |
| 507 | 501 | 495 | 489 | 481 | 475 | 469 | 462 | 453 | 447 | 440 | 433 | 3/8 | 50 |
| 537 | 531 | 525 | 519 | 510 | 504 | 497 | 493 | 483 | 476 | 467 | 460 | 7/16 | " |
| 568 | 562 | 555 | 547 | 540 | 533 | 526 | 519 | 512 | 504 | 497 | 487 | 1/2 | " |
| 596 | 590 | 583 | 577 | 570 | 563 | 555 | 548 | 538 | 530 | 522 | 514 | 9/16 | " |
| 625 | 618 | 612 | 604 | 597 | 590 | 579 | 571 | 563 | 555 | 547 | 539 | 5/8 | " |
| 654 | 647 | 640 | 630 | 622 | 614 | 606 | 598 | 589 | 581 | 572 | 561 | 11/16 | " |
| 682 | 675 | 665 | 657 | 649 | 641 | 632 | 623 | 615 | 603 | 594 | 585 | 3/4 | " |
| 540 | 532 | 526 | 520 | 511 | 504 | 497 | 490 | 481 | 474 | 466 | 457 | 3/8 | 55 |
| 569 | 562 | 556 | 549 | 542 | 533 | 526 | 519 | 511 | 501 | 494 | 486 | 7/16 | " |
| 599 | 593 | 586 | 579 | 570 | 562 | 555 | 547 | 540 | 532 | 521 | 513 | 1/2 | " |
| 630 | 623 | 616 | 607 | 599 | 592 | 584 | 576 | 568 | 560 | 552 | 540 | 9/16 | " |
| 659 | 652 | 645 | 637 | 627 | 619 | 611 | 602 | 594 | 585 | 577 | 565 | 5/8 | " |
| 687 | 680 | 670 | 662 | 654 | 646 | 637 | 628 | 620 | 608 | 599 | 590 | 11/16 | " |
| 716 | 706 | 698 | 690 | 681 | 673 | 664 | 652 | 643 | 633 | 624 | 614 | 3/4 | " |

*For detail dimensions see page 205.*

# SAFE LOADS IN THOUSANDS OF POUNDS HOLLOW ROUND CAST IRON COLUMNS SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{10\,000}{1 + \dfrac{l^2}{800\,d^2}}$.

P=safe load in pounds per square inch.
l=length of column in inches.
d=outside diameter of column in inches.
Ultimate compressive strength=80 000 pounds per square inch. Safety fac
Safe loads for other safety factors than that of the tables may be obtained
lows:—New safe load=Safe load from table $\times \dfrac{8}{\text{New factor}}$.

| Diameter in Inches. | Thickness in Inches. | Length of Column in Feet. | | | | | | | | | | Area of Metal in Sq. Ins. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | |
| 6 | 3/4 | 105 | 94 | 82 | 72 | 62 | 54 | 47 | 41 | 36 | 32 | 12.4 |
| | 7/8 | 119 | 107 | 94 | 82 | 71 | 62 | 54 | 47 | 41 | 36 | 14.1 |
| 7 | 3/4 | 130 | 119 | 108 | 96 | 86 | 76 | 67 | 60 | 53 | 47 | 14.7 |
| | 7/8 | 149 | 136 | 123 | 110 | 98 | 87 | 77 | 68 | 61 | 54 | 16.8 |
| 8 | 3/4 | 155 | 145 | 133 | 122 | 110 | 99 | 89 | 80 | 72 | 65 | 17.1 |
| | 7/8 | 178 | 166 | 153 | 139 | 126 | 114 | 104 | 92 | 83 | 75 | 19.6 |
| | 1 | 200 | 186 | 172 | 158 | 142 | 128 | 115 | 103 | 93 | 84 | 22.0 |
| 9 | 7/8 | 207 | 196 | 183 | 169 | 159 | 142 | 130 | 118 | 108 | 98 | 22.3 |
| | 1 | 2 8 | 220 | 206 | 190 | 179 | 160 | 146 | 133 | 121 | 110 | 25.1 |
| | 1 1/8 | 258 | 244 | 228 | 211 | 198 | 177 | 162 | 147 | 134 | 122 | 27.8 |
| 10 | 7/8 | 235 | 225 | 212 | 199 | 185 | 172 | 158 | 146 | 134 | 123 | 25.1 |
| | 1 | 265 | 254 | 240 | 224 | 209 | 194 | 178 | 164 | 151 | 139 | 28.3 |
| | 1 1/8 | 294 | 281 | 266 | 249 | 232 | 215 | 198 | 182 | 168 | 154 | 31.4 |
| | 1 1/4 | 323 | 308 | 291 | 273 | 254 | 235 | 217 | 200 | 184 | 169 | 34.4 |
| 11 | 1 | 298 | 287 | 273 | 259 | 243 | 227 | 212 | 197 | 183 | 169 | 31.4 |
| | 1 1/8 | 330 | 317 | 304 | 287 | 270 | 253 | 235 | 219 | 203 | 188 | 34.9 |
| | 1 1/4 | 363 | 350 | 333 | 315 | 296 | 277 | 258 | 240 | 223 | 206 | 38.3 |
| | 1 3/8 | 395 | 380 | 361 | 342 | 322 | 301 | 280 | 261 | 242 | 224 | 41.6 |
| 12 | 1 1/8 | 368 | 356 | 342 | 326 | 309 | 291 | 274 | 256 | 239 | 223 | 38.4 |
| | 1 1/4 | 404 | 391 | 375 | 358 | 339 | 320 | 300 | 281 | 263 | 245 | 42.2 |
| | 1 3/8 | 439 | 425 | 408 | 389 | 369 | 348 | 327 | 306 | 287 | 267 | 45.9 |
| | 1 1/2 | 473 | 458 | 440 | 419 | 397 | 375 | 352 | 330 | 308 | 288 | 49.5 |
| 13 | 1 1/8 | 404 | 393 | 379 | 364 | 347 | 330 | 312 | 294 | 277 | 260 | 42.0 |
| | 1 1/4 | 444 | 432 | 417 | 400 | 382 | 363 | 343 | 323 | 304 | 286 | 46.1 |
| | 1 3/8 | 484 | 470 | 454 | 435 | 415 | 395 | 373 | 352 | 33 | 311 | 50.2 |
| | 1 1/2 | 522 | 507 | 490 | 470 | 448 | 426 | 403 | 380 | 358 | 336 | 54.2 |
| 14 | 1 1/4 | 485 | 473 | 459 | 442 | 424 | 405 | 386 | 366 | 347 | 327 | 50.1 |
| | 1 3/8 | 528 | 515 | 499 | 482 | 462 | 441 | 420 | 399 | 378 | 357 | 54.5 |
| | 1 1/2 | 570 | 556 | 540 | 520 | 499 | 477 | 454 | 431 | 408 | 385 | 58.9 |
| | 1 5/8 | 612 | 597 | 579 | 558 | 535 | 511 | 487 | 462 | 437 | 413 | 63.2 |
| 15 | 1 3/8 | 573 | 560 | 545 | 528 | 509 | 489 | 467 | 446 | 424 | 406 | 58.9 |
| | 1 1/2 | 618 | 605 | 589 | 570 | 550 | 528 | 505 | 482 | 459 | 439 | 63.6 |
| | 1 5/8 | 664 | 650 | 632 | 612 | 590 | 567 | 542 | 517 | 492 | 471 | 68.3 |
| | 1 3/4 | 708 | 694 | 675 | 653 | 630 | 605 | 577 | 552 | 525 | 502 | 72.8 |
| 16 | 1 1/2 | 666 | 654 | 638 | 620 | 600 | 579 | 557 | 533 | 510 | 486 | 68.3 |
| | 1 5/8 | 716 | 702 | 686 | 666 | 645 | 622 | 598 | 573 | 548 | 522 | 73.4 |
| | 1 3/4 | 764 | 750 | 732 | 711 | 689 | 664 | 638 | 611 | 584 | 558 | 78.3 |
| | 1 7/8 | 909 | 892 | 871 | 846 | 819 | 790 | 759 | 725 | 695 | 663 | 93.2 |

# SAFE LOADS IN THOUSANDS OF POUNDS FOR HOLLOW ROUND CAST IRON COLUMNS. SQUARE ENDS.

**Based on Gordon's Formula** $P = \dfrac{10\,000}{1 + \dfrac{l^2}{800\,d^2}}$.

P=safe load in pounds per square inch.
l=length of column in inches.
d=outside diameter of column in inches.
Ultimate compressive strength=80 000 pounds per square inch. Safety factor 8.
Safe loads for other safety factors than that of the tables may be obtained as follows:—New safe load=Safe load from table $\times \dfrac{8}{\text{New factor}}$.

| Diameter in Inches. | Thickness in Inches. | Length of Column in Feet. | | | | | | | | | | Area of Metal in Sq. Ins. | Weight per Foot in Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | | |
| 18 | 1⅝ | 754 | 732 | 708 | 684 | 659 | 633 | 608 | 596 | 557 | 533 | 83.6 | 261.2 |
| | 1¾ | 806 | 782 | 757 | 732 | 704 | 677 | 650 | 637 | 596 | 569 | 89.3 | 279.2 |
| | 1⅞ | 857 | 832 | 805 | 777 | 749 | 720 | 691 | 677 | 633 | 605 | 95.0 | 296.8 |
| | 2 | 907 | 880 | 852 | 823 | 792 | 762 | 731 | 717 | 670 | 641 | 100.5 | 314.2 |
| 20 | 1¾ | 922 | 900 | 876 | 850 | 824 | 797 | 769 | 742 | 714 | 687 | 100.3 | 313.6 |
| | 1⅞ | 981 | 957 | 932 | 905 | 877 | 848 | 819 | 789 | 760 | 731 | 106.8 | 333.6 |
| | 2 | 1039 | 1014 | 987 | 958 | 929 | 898 | 867 | 836 | 805 | 774 | 113.1 | 353.4 |
| | 2⅛ | 1097 | 1070 | 1041 | 1011 | 980 | 948 | 915 | 882 | 849 | 817 | 119.3 | 372.9 |
| 22 | 1⅞ | 1105 | 1082 | 1058 | 1032 | 1005 | 976 | 947 | 918 | 888 | 859 | 118.5 | 370.5 |
| | 2 | 1171 | 1147 | 1122 | 1094 | 1065 | 1035 | 1004 | 974 | 941 | 910 | 125.7 | 392.7 |
| | 2⅛ | 1239 | 1213 | 1186 | 1157 | 1126 | 1094 | 1062 | 1029 | 996 | 962 | 132.9 | 415.3 |
| | 2¼ | 1301 | 1275 | 1246 | 1215 | 1183 | 1150 | 1116 | 1081 | 1046 | 1011 | 139.6 | 436.3 |
| 24 | 2 | 1303 | 1280 | 1241 | 1229 | 1201 | 1171 | 1141 | 1110 | 1079 | 1047 | 138.2 | 432.0 |
| | 2⅛ | 1376 | 1352 | 1311 | 1298 | 1268 | 1238 | 1206 | 1173 | 1140 | 1106 | 146.0 | 456.4 |
| | 2¼ | 1449 | 1423 | 1380 | 1367 | 1335 | 1303 | 1269 | 1235 | 1200 | 1165 | 153.7 | 480.4 |
| | 2⅜ | 1520 | 1494 | 1448 | 1434 | 1402 | 1367 | 1332 | 1296 | 1259 | 1222 | 161.4 | 504.2 |
| 26 | 2⅛ | 1515 | 1492 | 1467 | 1440 | 1412 | 1382 | 1351 | 1319 | 1286 | 1252 | 159.4 | 498.1 |
| | 2¼ | 1596 | 1572 | 1546 | 1517 | 1487 | 1456 | 1423 | 1389 | 1354 | 1319 | 167.9 | 524.6 |
| | 2⅜ | 1675 | 1650 | 1623 | 1593 | 1562 | 1528 | 1494 | 1458 | 1422 | 1385 | 176.3 | 550.9 |
| | 2½ | 1754 | 1728 | 1699 | 1668 | 1635 | 1600 | 1564 | 1527 | 1489 | 1450 | 184.6 | 576.8 |
| 28 | 2¼ | 1742 | 1719 | 1694 | 1667 | 1638 | 1608 | 1576 | 1542 | 1508 | 1474 | 182.0 | 568.8 |
| | 2⅜ | 1829 | 1806 | 1780 | 1751 | 1721 | 1689 | 1655 | 1620 | 1584 | 1548 | 191.2 | 597.5 |
| | 2½ | 1917 | 1892 | 1864 | 1834 | 1802 | 1769 | 1734 | 1697 | 1660 | 1622 | 200.3 | 625.9 |
| | 2⅝ | 2002 | 1967 | 1948 | 1917 | 1883 | 1848 | 1811 | 1773 | 1734 | 1694 | 209.3 | 653.9 |
| 30 | 2⅜ | 1982 | 1961 | 1936 | 1909 | 1879 | 1848 | 1816 | 1782 | 1747 | 1711 | 206.1 | 644.1 |
| | 2½ | 2078 | 2055 | 2028 | 2000 | 1969 | 1937 | 1903 | 1867 | 1830 | 1793 | 216.0 | 675.0 |
| | 2⅝ | 2172 | 2148 | 2119 | 2090 | 2058 | 2024 | 1989 | 1952 | 1913 | 1874 | 225.8 | 705.5 |
| | 2¾ | 2265 | 2240 | 2210 | 2180 | 2147 | 2111 | 2074 | 2035 | 1995 | 1954 | 235.4 | 735.7 |
| 32 | 2½ | 2239 | 2217 | 2192 | 2165 | 2135 | 2104 | 2071 | 2036 | 2000 | 1963 | 231.7 | 724.0 |
| | 2⅝ | 2341 | 2318 | 2292 | 2264 | 2233 | 2200 | 2165 | 2129 | 2092 | 2053 | 242.2 | 757.0 |
| | 2¾ | 2442 | 2418 | 2391 | 2361 | 2329 | 2295 | 2259 | 2221 | 2182 | 2141 | 252.7 | 789.7 |
| | 2⅞ | 2542 | 2517 | 2489 | 2458 | 2424 | 2389 | 2351 | 2312 | 2271 | 2229 | 263.1 | 822.1 |
| 34 | 2⅝ | 2511 | 2488 | 2463 | 2436 | 2406 | 2374 | 2341 | 2306 | 2272 | 2232 | 258.7 | 808.6 |
| | 2¾ | 2620 | 2596 | 2570 | 2542 | 2511 | 2478 | 2441 | 2406 | 2370 | 2329 | 270.0 | 843.7 |
| | 2⅞ | 2728 | 2703 | 2676 | 2646 | 2614 | 2580 | 2544 | 2505 | 2468 | 2425 | 281.1 | 878.5 |
| | 3 | 2835 | 2810 | 2781 | 2750 | 2717 | 2681 | 2643 | 2604 | 2565 | 2520 | 292.2 | 913.0 |
| 36 | 2¾ | 2796 | 2774 | 2749 | 2721 | 2692 | 2660 | 2626 | 2591 | 2553 | 2515 | 287.3 | 897.7 |
| | 2⅞ | 2913 | 2889 | 2863 | 2834 | 2803 | 2770 | 2735 | 2698 | 2659 | 2619 | 299.2 | 935.0 |
| | 3 | 3028 | 3003 | 2976 | 2946 | 2904 | 2880 | 2849 | 2805 | 2765 | 2723 | 311.0 | 971.9 |

## STRENGTH OF HOLLOW ROUND AND HOLLOW RECTANGULAR CAST IRON COLUMNS.

For various values of $\frac{L}{d}$ in which:—

L = length of column in feet.
d = least outside diameter in inches.
P = ultimate strength in pounds per square inch.

BASED ON GORDON'S FORMULÆ FOR COLUMNS WITH SQUARE ENDS.

HOLLOW ROUND.

$$P = \frac{80000}{1 + \frac{(12L)^2}{800\,d^2}}$$

HOLLOW RECTANGULAR.

$$P = \frac{80000}{1 + \frac{(12L)^2}{1067\,d^2}}$$

| $\frac{L}{d}$ | Ultimate Strength in lbs. per sq. in. | | $\frac{L}{d}$ | Ultimate Strength in lbs. per sq. in. | |
|---|---|---|---|---|---|
| | Hollow Round. | Hollow Rectangular. | | Hollow Round. | Hollow Rectangular. |
| 1.0 | 67800 | 70487 | 2.5 | 37647 | 43396 |
| 1.1 | 65692 | 68770 | 2.6 | 36088 | 41834 |
| 1.2 | 63532 | 66983 | 2.7 | 34599 | 40326 |
| 1.3 | 61340 | 65142 | 2.8 | 33178 | 38871 |
| 1.4 | 59137 | 63265 | 2.9 | 31817 | 37471 |
| 1.5 | 56940 | 61366 | 3.0 | 30534 | 36123 |
| 1.6 | 54766 | 59458 | 3.1 | 29306 | 34829 |
| 1.7 | 52625 | 57553 | 3.2 | 28137 | 33586 |
| 1.8 | 50531 | 55660 | 3.3 | 27025 | 32393 |
| 1.9 | 48491 | 53792 | 3.4 | 25967 | 31249 |
| 2.0 | 46512 | 51954 | 3.5 | 24961 | 30152 |
| 2.1 | 44598 | 50151 | 3.6 | 24004 | 29101 |
| 2.2 | 42753 | 48391 | 3.7 | 23093 | 28094 |
| 2.3 | 40979 | 46676 | 3.8 | 22227 | 27130 |
| 2.4 | 39277 | 45011 | 3.9 | 21403 | 26206 |

Safe loads for any given hollow round or hollow rectangular columns, corresponding to any suitable factor of safety can be found from the above table as follows:—

Find from the table the ultimate strength in pounds per square inch corresponding to the given value of $\frac{L}{d}$. Multiply this by the area of the column in square inches and divide the product by the safety factor which will give as a quotient the required safe load in pounds.

EXAMPLE:—Required the safe load for a hollow round cast iron column 16 feet long, 10 inches external diameter with metal 1 inch thick with safety factor of eight.

The ratio of $\frac{L}{d}$ in this case is $\frac{16}{10} = 1.6$ and the corresponding ultimate strength from the tables is 54 766 pounds per square inch.

From the table of areas of circles it is found that the net area of the column is 28.3 square inches. The safe load is therefore $\frac{54\,766 \times 28.3}{8} = 193\,735$ pounds or *approximately 97* net tons, which is the required result.

## XPLANATIONS OF TABLES OF SAFE LOADS FOR BEAM BOX-GIRDERS AND PLATE GIRDERS, PAGES 248 TO 262 INCLUSIVE.

For cases in which the loads to be carried exceed the capacities of single rolled eams or ordinary beam girders composed of two or more beams with the usual olts and separators, it is necessary to use built-up sections.

BEAM BOX-GIRDERS.—A useful and economical section of this kind can be com-osed of two rolled beams with plates riveted to the top and bottom flanges, making beam box-girder, tables of safe uniformly distributed loads for which are given on pages 248 to 257 inclusive.

The safe loads given in the tables include the weights of the beam box-girders, and are figured from the moment of inertia or section modulus after making the necessary deductions for rivet holes, the fibre stress used in the calculations being 15 000 pounds per square inch of net section.

Beam box-girders are particularly useful for supporting wide walls and in other locations up to the limits of their capacity, but they should not be placed where ex-posed to moisture, as the section is such that access cannot be had to their interior for inspection and painting.

PLATE GIRDERS.—In cases where the widths of beam box-girders would prohibit their use, and for loads greater than their capacities, plate girders composed of plates and angles may be used.

Tables of safe loads uniformly distributed for plate girders from 24″ to 48″ deep are given on pages 258 to 262 inclusive.

The loads given in the tables include the weights of the girders and are calcu-ated from the moment of inertia or section modulus after making a proper deduc-ion for rivet holes, the fibre stress used in the calculations being 15 000 pounds per quare inch of net section.

Although the tables do not show the stiffener angles for plate girders, care hould be taken that these are provided in all cases where necessary to prevent uckling of the web due to the shearing action therein. The stiffeners should be nade of angles riveted to the web, fitted tightly between the top and bottom flange ngles, and they should be provided, at the ends of the girders, of such size and num-er as to be capable of carrying the total reaction at each end to the supports. Stif-eners should also be provided at intervals along the girder, spaced at suitable dis-ances apart as determined by the formula and explanations on pages 66 and 67.

Care should also be taken in arranging the rivet spacing for connecting the flange ngles to the web, so that sufficient rivets are provided to properly transmit the tresses which act between these two portions of the construction. This will require he rivets to be spaced more closely at the ends than at the centre, and the exact pacing at any point along the girder may be obtained by dividing the product of he distance between the centre lines of the rivet holes in the two flanges and the esistance of one rivet by the total vertical shear at the given point, thus:

$$p = \frac{r\,h}{S} \quad \text{in which}$$

S = the total vertical shear, in pounds, at the point under consideration.
r = the resistance of one rivet, *i. e.*, the bearing value or shearing value, which-ever is the smaller, expressed in pounds.
h = the depth of the girder between the upper and lower centre lines of rivets, expressed in inches.
p = pitch of rivets in the flange angles, expressed in inches.

The formula above will give the theoretical rivet spacing at any point in the anges due to the total shear, but in practice the pitch for various portions of the ength should be stated for the least possible number of spacing panels containing n even number of spaces, the pitch in each of which should preferably be expressed n even inches or even inches and halves or quartets of an inch, and the usual limits f pitch will vary from 2½″ to 6″.

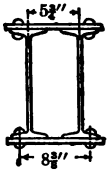
The rivet spacing should also conform to the rules given on page 278, and in ases where loads are applied directly to the flanges, sufficient rivets must be pro-ided to carry these in addition to the rivets necessary for securing the web and anges together as explained above.

It should also be noted that the safe loads given in the tables are based on the ssumption that the girder is supported laterally, otherwise a proper reduction in he allowable safe load must be made, as explained in connection with beams on ages 64 and 65.

The weights of beam box-girders and plate-girders in the tables are expressed in ounds per lineal foot, including the rivets necessary to secure the web and flanges ogether, but the weights *do not* include any allowance for brackets, stiffeners, onnections *or other details, as these* will vary, dependent upon the conditions of *ch case.*

# SAFE LOADS IN THOUSANDS OF POUND UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

Safe loads below are figured for fibre stress of 15 000 pounds per square inc
$\frac{11}{16}$″ rivet holes in both flanges deducted, and include weight of girder.




2–Plates 12″ Wide.

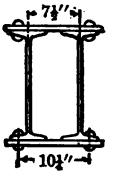
2–10″ I-Beams 25 lbs. per foot.

| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾″ Use Two Plates. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | ½ | 9/16 | ⅝ | 11/16 | ¾ | 13/16 | ⅞ | 15/16 |
| 10 | 90 | 96 | 102 | 109 | 115 | 121 | 127 | 134 |
| 11 | 82 | 87 | 93 | 99 | 104 | 110 | 116 | 121 |
| 12 | 75 | 80 | 85 | 90 | 96 | 101 | 106 | 111 |
| 13 | 69 | 74 | 79 | 84 | 88 | 93 | 98 | 103 |
| 14 | 64 | 69 | 73 | 78 | 82 | 86 | 91 | 95 |
| 15 | 60 | 64 | 68 | 72 | 77 | 81 | 85 | 89 |
| 16 | 56 | 60 | 64 | 68 | 72 | 76 | 80 | 83 |
| 17 | 53 | 57 | 60 | 64 | 68 | 71 | 75 | 79 |
| 18 | 50 | 53 | 57 | 60 | 64 | 67 | 71 | 74 |
| 19 | 47 | 51 | 54 | 57 | 60 | 64 | 67 | 70 |
| 20 | 45 | 48 | 51 | 54 | 57 | 60 | 64 | 67 |
| 21 | 43 | 46 | 49 | 52 | 55 | 58 | 61 | 64 |
| 22 | 41 | 44 | 47 | 49 | 52 | 55 | 58 | 61 |
| 23 | 39 | 42 | 45 | 47 | 50 | 53 | 55 | 58 |
| 24 | 38 | 40 | 43 | 45 | 48 | 50 | 53 | 56 |
| 25 | 36 | 38 | 41 | 43 | 46 | 48 | 51 | 53 |
| 26 | 35 | 37 | 39 | 42 | 44 | 47 | 49 | 51 |
| 27 | 33 | 36 | 38 | 40 | 43 | 45 | 47 | 49 |
| 28 | 32 | 34 | 37 | 39 | 41 | 43 | 45 | 48 |
| 29 | 31 | 33 | 35 | 37 | 40 | 42 | 44 | 46 |
| 30 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 45 |
| 31 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 |
| 32 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 |
| 33 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 40 |
| 34 | 26 | 28 | 30 | 32 | 34 | 36 | 37 | 39 |
| Weight per Foot in Pounds. | 94.6 | 99.8 | 104.8 | 110.0 | 115.0 | 120.1 | 125.2 | 130. |
| Section Modulus. | 90.1 | 96.3 | 102.4 | 108.6 | 114.8 | 121.0 | 127.2 | 133. |
| Coefficient of Deflection. | 0.00000145 | | | 0.00000118 | | | 0.0000 | |

*For safe* loads below the heavy lines, the deflections will be greater *allowable limit* for plastered ceilings = $\frac{1}{360}$ span.

# AFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

ads below are figured for fibre stress of 15 000 pounds per square inch, with holes in both flanges deducted, and include weight of girder.

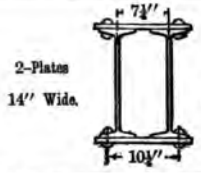



| enter of in | Thickness of Plates in Inches. For Thicknesses Greater than ¾" Use Two Plates. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ½ | 9/16 | ⅝ | 11/16 | ¾ | 13/16 | ⅞ | 15/16 | 1 |
| | 132 | 141 | 150 | 159 | 167 | 176 | 185 | 194 | 203 |
| | 120 | 128 | 136 | 144 | 152 | 160 | 168 | 177 | 185 |
| | 110 | 117 | 125 | 132 | 140 | 147 | 154 | 162 | 169 |
| | 102 | 108 | 115 | 122 | 129 | 136 | 143 | 149 | 156 |
| | 94 | 101 | 107 | 113 | 120 | 126 | 132 | 139 | 145 |
| | 88 | 94 | 100 | 106 | 112 | 118 | 123 | 129 | 135 |
| | 83 | 88 | 94 | 99 | 105 | 110 | 116 | 121 | 127 |
| | 78 | 83 | 88 | 93 | 98 | 104 | 109 | 114 | 120 |
| | 73 | 78 | 83 | 88 | 93 | 98 | 103 | 108 | 113 |
| | 70 | 74 | 79 | 83 | 88 | 93 | 98 | 102 | 107 |
| | 66 | 70 | 75 | 79 | 84 | 88 | 93 | 97 | 102 |
| | 63 | 67 | 71 | 76 | 80 | 84 | 88 | 92 | 97 |
| | 60 | 64 | 68 | 72 | 76 | 80 | 84 | 88 | 92 |
| | 57 | 61 | 65 | 69 | 73 | 77 | 81 | 84 | 88 |
| | 55 | 59 | 62 | 66 | 70 | 73 | 77 | 81 | 85 |
| | 53 | 56 | 60 | 63 | 67 | 71 | 74 | 78 | 81 |
| | 51 | 54 | 58 | 61 | 64 | 68 | 71 | 75 | 78 |
| | 49 | 52 | 55 | 59 | 62 | 65 | 69 | 72 | 75 |
| | 47 | 50 | 53 | 57 | 60 | 63 | 66 | 69 | 73 |
| | 46 | 49 | 52 | 55 | 58 | 61 | 64 | 67 | 70 |
| | 44 | 47 | 50 | 53 | 56 | 59 | 62 | 65 | 68 |
| | 43 | 45 | 48 | 51 | 54 | 57 | 60 | 63 | 66 |
| | 41 | 44 | 47 | 50 | 52 | 55 | 58 | 61 | 64 |
| | 40 | 43 | 45 | 48 | 51 | 53 | 56 | 59 | 62 |
| | 39 | 41 | 44 | 47 | 49 | 52 | 54 | 57 | 60 |
| per unds. | 114.4 | 120.4 | 126.3 | 132.3 | 138.3 | 144.2 | 150.1 | 156.1 | 162.0 |
| n is. | 132.1 | 140.9 | 149.7 | 158.5 | 167.4 | 176.3 | 185.3 | 194.2 | 203.2 |
| it of on. | 0.000000842 | | | 0.000000688 | | | 0.000000577 | | |

afe loads *below the heavy* lines, the deflections will be greater than the *e limit for plastered ceilings* = 1/360 span.

# SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

Safe loads below are figured for fibre stress of 15 000 pounds per square inch, with $\frac{13}{16}$" rivet holes in both flanges deducted, and include weight of girder.

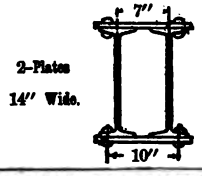



| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾" Use Two Plates. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ½ | 9/16 | ⅝ | 11/16 | ¾ | 13/16 | ⅞ | 15/16 | 1 |
| 10 | 147 | 155 | 164 | 173 | 181 | 190 | 199 | 208 | 217 |
| 11 | 133 | 141 | 149 | 157 | 165 | 173 | 181 | 189 | 197 |
| 12 | 122 | 129 | 137 | 144 | 151 | 158 | 166 | 173 | 181 |
| 13 | 113 | 119 | 126 | 133 | 140 | 146 | 153 | 160 | 167 |
| 14 | 105 | 111 | 117 | 123 | 130 | 136 | 142 | 148 | 155 |
| 15 | 98 | 104 | 109 | 115 | 121 | 127 | 133 | 139 | 144 |
| 16 | 92 | 97 | 102 | 108 | 113 | 119 | 124 | 130 | 135 |
| 17 | 86 | 91 | 96 | 102 | 107 | 112 | 117 | 122 | 127 |
| 18 | 81 | 86 | 91 | 96 | 101 | 106 | 111 | 115 | 120 |
| 19 | 77 | 82 | 86 | 91 | 95 | 100 | 105 | 109 | 114 |
| 20 | 73 | 78 | 82 | 86 | 91 | 95 | 99 | 104 | 108 |
| 21 | 70 | 74 | 78 | 82 | 86 | 91 | 95 | 99 | 103 |
| 22 | 67 | 71 | 75 | 78 | 82 | 86 | 90 | 94 | 99 |
| 23 | 64 | 68 | 71 | 75 | 79 | 83 | 87 | 90 | 94 |
| 24 | 61 | 65 | 68 | 72 | 76 | 79 | 83 | 87 | 90 |
| 25 | 59 | 62 | 66 | 69 | 73 | 76 | 80 | 83 | 87 |
| 26 | 56 | 60 | 63 | 66 | 70 | 73 | 77 | 80 | 83 |
| 27 | 54 | 58 | 61 | 64 | 67 | 70 | 74 | 77 | 80 |
| 28 | 52 | 55 | 59 | 62 | 65 | 68 | 71 | 74 | 77 |
| 29 | 51 | 54 | 57 | 60 | 63 | 66 | 69 | 72 | 75 |
| 30 | 49 | 52 | 55 | 58 | 60 | 63 | 66 | 69 | 72 |
| 31 | 47 | 50 | 53 | 56 | 59 | 61 | 64 | 67 | 70 |
| 32 | 46 | 49 | 51 | 54 | 57 | 59 | 62 | 65 | 68 |
| 33 | 44 | 47 | 50 | 52 | 55 | 58 | 60 | 63 | 66 |
| 34 | 43 | 46 | 48 | 51 | 53 | 56 | 59 | 61 | 64 |
| Weight per Foot in Pounds. | 131.4 | 137.4 | 143.3 | 149.3 | 155.3 | 161.2 | 167.1 | 173.1 | 179.0 |
| Section Modulus. | 146.6 | 155.3 | 163.9 | 172.7 | 181.4 | 190.2 | 199.0 | 207.8 | 216.7 |
| Coefficient of Deflection. | 0.000000763 | | | 0.000000635 | | | 0.000000539 | | |

*For safe loads* below the heavy lines, the deflections will be greater than the *allowable limit* for plastered ceilings = $\frac{1}{360}$ span.

# SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

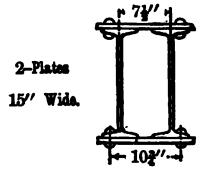
Safe loads below are figured for fibre stress of 15 000 pounds per square inch, with $\frac{13}{16}$" rivet holes in both flanges deducted, and include weight of girder.




| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾" Use Two Plates. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\frac{5}{8}$ | $\frac{11}{16}$ | $\frac{3}{4}$ | $\frac{13}{16}$ | $\frac{7}{8}$ | $\frac{15}{16}$ | 1 | $1\frac{1}{16}$ | $1\frac{1}{8}$ | $1\frac{3}{16}$ | $1\frac{1}{4}$ |
| 10 | 212 | 223 | 234 | 245 | 256 | 267 | 278 | 289 | 300 | 312 | 323 |
| 11 | 193 | 203 | 213 | 223 | 233 | 243 | 253 | 263 | 273 | 283 | 293 |
| 12 | 177 | 186 | 195 | 204 | 213 | 223 | 232 | 241 | 250 | 260 | 269 |
| 13 | 163 | 172 | 180 | 188 | 197 | 205 | 214 | 223 | 231 | 240 | 248 |
| 14 | 151 | 159 | 167 | 175 | 183 | 191 | 199 | 207 | 215 | 223 | 231 |
| 15 | 141 | 149 | 156 | 163 | 171 | 178 | 185 | 193 | 200 | 208 | 215 |
| 16 | 133 | 139 | 146 | 153 | 160 | 167 | 174 | 181 | 188 | 195 | 202 |
| 17 | 125 | 131 | 138 | 144 | 151 | 157 | 164 | 170 | 177 | 183 | 190 |
| 18 | 118 | 124 | 130 | 136 | 142 | 148 | 155 | 161 | 167 | 173 | 179 |
| 19 | 112 | 117 | 123 | 129 | 135 | 141 | 146 | 152 | 158 | 164 | 170 |
| 20 | 106 | 112 | 117 | 122 | 128 | 134 | 139 | 145 | 150 | 156 | 161 |
| 21 | 101 | 106 | 111 | 117 | 122 | 127 | 132 | 138 | 143 | 148 | 154 |
| 22 | 96 | 101 | 106 | 111 | 116 | 121 | 126 | 131 | 137 | 142 | 147 |
| 23 | 92 | 97 | 102 | 107 | 111 | 116 | 121 | 126 | 131 | 135 | 140 |
| 24 | 88 | 93 | 98 | 102 | 107 | 111 | 116 | 121 | 125 | 130 | 135 |
| 25 | 85 | 89 | 94 | 98 | 102 | 107 | 111 | 116 | 120 | 125 | 129 |
| 26 | 82 | 86 | 90 | 94 | 98 | 103 | 107 | 111 | 116 | 120 | 124 |
| 27 | 79 | 83 | 87 | 91 | 95 | 99 | 103 | 107 | 111 | 115 | 120 |
| 28 | 76 | 80 | 84 | 88 | 91 | 95 | 99 | 103 | 107 | 111 | 115 |
| 29 | 73 | 77 | 81 | 84 | 88 | 92 | 96 | 100 | 104 | 107 | 111 |
| 30 | 71 | 74 | 78 | 82 | 85 | 89 | 93 | 96 | 100 | 104 | 108 |
| 31 | 68 | 72 | 75 | 79 | 83 | 86 | 90 | 93 | 97 | 101 | 104 |
| 32 | 66 | 70 | 73 | 77 | 80 | 83 | 87 | 90 | 94 | 97 | 101 |
| 33 | 64 | 68 | 71 | 74 | 78 | 81 | 84 | 88 | 91 | 94 | 98 |
| 34 | 62 | 66 | 69 | 72 | 75 | 79 | 82 | 85 | 88 | 92 | 95 |
| Weight per Ft. in Pounds. | 147.3 | 153.3 | 159.3 | 165.2 | 171.1 | 177.1 | 183.0 | 189.0 | 194.9 | 200.9 | 206.8 |
| Section Modulus. | 212.1 | 223.0 | 234.0 | 245.0 | 256.0 | 267.1 | 278.2 | 289.3 | 300.5 | 311.6 | 322.8 |
| Coefficient of Deflection. | 0.000000426 | | | 0.000000362 | | | 0.000000314 | | | 0.000000281 | |

# SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

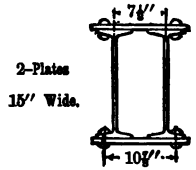
Safe loads below are figured for fiber stress of 15 000 pounds per square inch $\frac{7}{8}$" rivet holes in both flanges deducted, and include weight of girder.




| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾" Use Two Plates. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\frac{5}{8}$ | $\frac{11}{16}$ | $\frac{3}{4}$ | $\frac{13}{16}$ | $\frac{7}{8}$ | $\frac{15}{16}$ | 1 | $1\frac{1}{16}$ | $1\frac{1}{8}$ | $1\frac{3}{16}$ |
| 10 | 259 | 271 | 282 | 294 | 306 | 318 | 329 | 341 | 353 | 365 |
| 11 | 236 | 246 | 257 | 267 | 278 | 289 | 299 | 310 | 321 | 332 |
| 12 | 216 | 226 | 235 | 245 | 255 | 265 | 274 | 284 | 294 | 304 |
| 13 | 199 | 208 | 217 | 226 | 235 | 244 | 253 | 262 | 272 | 281 |
| 14 | 185 | 193 | 202 | 210 | 218 | 227 | 235 | 244 | 252 | 261 |
| 15 | 173 | 181 | 188 | 196 | 204 | 212 | 220 | 227 | 235 | 243 |
| 16 | 162 | 169 | 177 | 184 | 191 | 198 | 206 | 213 | 221 | 228 |
| 17 | 152 | 159 | 166 | 173 | 180 | 187 | 194 | 201 | 208 | 215 |
| 18 | 144 | 150 | 157 | 163 | 170 | 176 | 183 | 190 | 196 | 203 |
| 19 | 136 | 143 | 149 | 155 | 161 | 167 | 173 | 180 | 186 | 192 |
| 20 | 130 | 135 | 141 | 147 | 153 | 159 | 165 | 171 | 176 | 182 |
| 21 | 123 | 129 | 134 | 140 | 146 | 151 | 157 | 162 | 168 | 174 |
| 22 | 118 | 123 | 128 | 134 | 139 | 144 | 150 | 155 | 160 | 166 |
| 23 | 113 | 118 | 123 | 128 | 133 | 138 | 143 | 148 | 153 | 159 |
| 24 | 108 | 113 | 118 | 123 | 127 | 132 | 137 | 142 | 147 | 152 |
| 25 | 104 | 108 | 113 | 118 | 122 | 127 | 132 | 136 | 141 | 146 |
| 26 | 100 | 104 | 109 | 113 | 118 | 122 | 127 | 131 | 136 | 140 |
| 27 | 96 | 100 | 105 | 109 | 113 | 118 | 122 | 126 | 131 | 135 |
| 28 | 93 | 97 | 101 | 105 | 109 | 113 | 118 | 122 | 126 | 130 |
| 29 | 89 | 93 | 97 | 101 | 105 | 109 | 114 | 118 | 122 | 126 |
| 30 | 86 | 90 | 94 | 98 | 102 | 106 | 110 | 114 | 118 | 122 |
| 31 | 84 | 87 | 91 | 95 | 99 | 102 | 106 | 110 | 114 | 118 |
| 32 | 81 | 85 | 88 | 92 | 96 | 99 | 103 | 107 | 110 | 114 |
| 33 | 79 | 82 | 86 | 89 | 93 | 96 | 100 | 103 | 107 | 111 |
| 34 | 76 | 80 | 83 | 87 | 90 | 93 | 97 | 100 | 104 | 107 |
| Weight per Ft. in Pounds. | 187.6 | 194.0 | 200.4 | 206.7 | 213.1 | 219.5 | 225.8 | 232.2 | 238.6 | 245.0 |
| Section Modulus. | 259.2 | 270.8 | 282.4 | 294.1 | 305.8 | 317.5 | 329.3 | 341.1 | 353.0 | 364.9 |
| *Coefficient of Deflection.* | 0.000000350 | | | 0.000000303 | | | 0.000000266 | | | 0.000 |

# SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

Safe loads below are figured for fiber stress of 15 000 pounds per square inch, with $\frac{13}{16}$″ rivet holes in both flanges deducted, and include weight of girder.




| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾″ Use Two Plates. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\frac{5}{8}$ | $\frac{11}{16}$ | $\frac{3}{4}$ | $\frac{13}{16}$ | $\frac{7}{8}$ | $\frac{15}{16}$ | 1 | $1\frac{1}{16}$ | $1\frac{1}{8}$ | $1\frac{3}{16}$ | $1\frac{1}{4}$ |
| 10 | 300 | 311 | 322 | 334 | 345 | 357 | 368 | 380 | 391 | 403 | 414 |
| 11 | 272 | 283 | 293 | 303 | 314 | 324 | 335 | 345 | 356 | 366 | 377 |
| 12 | 250 | 259 | 269 | 278 | 288 | 297 | 307 | 316 | 326 | 336 | 345 |
| 13 | 231 | 239 | 248 | 257 | 265 | 274 | 283 | 292 | 301 | 310 | 319 |
| 14 | 214 | 222 | 230 | 238 | 247 | 255 | 263 | 271 | 279 | 288 | 296 |
| 15 | 200 | 207 | 215 | 222 | 230 | 238 | 245 | 253 | 261 | 269 | 276 |
| 16 | 187 | 194 | 201 | 209 | 216 | 223 | 230 | 237 | 244 | 252 | 259 |
| 17 | 176 | 183 | 190 | 196 | 203 | 210 | 217 | 223 | 230 | 237 | 244 |
| 18 | 167 | 173 | 179 | 185 | 192 | 198 | 204 | 211 | 217 | 224 | 230 |
| 19 | 158 | 164 | 170 | 176 | 182 | 188 | 194 | 200 | 206 | 212 | 218 |
| 20 | 150 | 156 | 161 | 167 | 173 | 178 | 184 | 190 | 196 | 201 | 207 |
| 21 | 143 | 148 | 154 | 159 | 164 | 170 | 175 | 181 | 186 | 192 | 197 |
| 22 | 136 | 141 | 147 | 152 | 157 | 162 | 167 | 173 | 178 | 183 | 188 |
| 23 | 130 | 135 | 140 | 145 | 150 | 155 | 160 | 165 | 170 | 173 | 180 |
| 24 | 125 | 130 | 134 | 139 | 144 | 149 | 153 | 158 | 163 | 168 | 173 |
| 25 | 120 | 124 | 129 | 133 | 138 | 143 | 147 | 152 | 156 | 161 | 166 |
| 26 | 115 | 120 | 124 | 128 | 133 | 137 | 142 | 146 | 150 | 155 | 159 |
| 27 | 111 | 115 | 119 | 124 | 128 | 132 | 136 | 141 | 145 | 149 | 153 |
| 28 | 107 | 111 | 115 | 119 | 123 | 127 | 131 | 136 | 140 | 144 | 148 |
| 29 | 103 | 107 | 111 | 115 | 119 | 123 | 127 | 131 | 135 | 139 | 143 |
| 30 | 100 | 104 | 107 | 111 | 115 | 119 | 123 | 127 | 130 | 134 | 138 |
| 31 | 97 | 100 | 104 | 108 | 111 | 115 | 119 | 122 | 126 | 130 | 134 |
| 32 | 94 | 97 | 101 | 104 | 108 | 111 | 115 | 119 | 122 | 126 | 130 |
| 33 | 91 | 94 | 98 | 101 | 105 | 108 | 112 | 115 | 119 | 122 | 126 |
| 34 | 88 | 91 | 95 | 98 | 102 | 105 | 108 | 112 | 115 | 118 | 122 |
| Weight per Ft. in Pounds. | 227.6 | 234.0 | 240.4 | 246.7 | 253.1 | 259.5 | 265.8 | 272.2 | 278.6 | 285.0 | 291.4 |
| Section Modulus. | 299.7 | 311.0 | 322.4 | 333.7 | 345.1 | 356.6 | 368.1 | 379.6 | 391.2 | 402.8 | 414.4 |
| Coefficient of Deflection. | 0.000000305 | | | 0.000000269 | | | 0.000000239 | | | 0.000000218 | |

# SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

Safe loads below are figured for fiber stress of 15000 pounds per square inch, with $\frac{13}{16}$″ rivet holes in both flanges deducted, and include weight of girder.

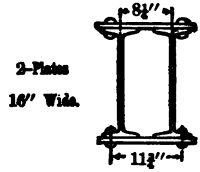
2-Plates 16″ Wide.

2-18″ I-Beams 55 lbs. per foot.

| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾″ Use Two Plates. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $\frac{3}{4}$ | $\frac{13}{16}$ | $\frac{7}{8}$ | $\frac{15}{16}$ | 1 | $1\frac{1}{16}$ | $1\frac{1}{8}$ | $1\frac{3}{16}$ | $1\frac{1}{4}$ | $1\frac{5}{16}$ | $1\frac{3}{8}$ |
| 15 | 227 | 237 | 247 | 258 | 268 | 278 | 289 | 299 | 309 | 320 | 330 |
| 16 | 213 | 222 | 232 | 242 | 251 | 261 | 271 | 280 | 290 | 300 | 310 |
| 17 | 200 | 209 | 218 | 227 | 237 | 246 | 255 | 264 | 273 | 282 | 291 |
| 18 | 189 | 198 | 206 | 215 | 223 | 232 | 241 | 249 | 258 | 267 | 275 |
| 19 | 179 | 187 | 195 | 203 | 212 | 220 | 228 | 236 | 244 | 253 | 261 |
| 20 | 170 | 178 | 186 | 193 | 201 | 209 | 217 | 224 | 232 | 240 | 248 |
| 21 | 162 | 169 | 177 | 184 | 191 | 199 | 206 | 214 | 221 | 228 | 236 |
| 22 | 155 | 162 | 169 | 176 | 183 | 190 | 197 | 204 | 211 | 218 | 225 |
| 23 | 148 | 155 | 161 | 168 | 175 | 182 | 188 | 195 | 202 | 209 | 215 |
| 24 | 142 | 148 | 155 | 161 | 168 | 174 | 180 | 187 | 193 | 200 | 206 |
| 25 | 136 | 142 | 148 | 155 | 161 | 167 | 173 | 179 | 186 | 192 | 198 |
| 26 | 131 | 137 | 143 | 149 | 155 | 161 | 167 | 173 | 179 | 185 | 191 |
| 27 | 126 | 132 | 137 | 143 | 149 | 155 | 160 | 166 | 172 | 178 | 183 |
| 28 | 122 | 127 | 133 | 138 | 144 | 149 | 155 | 160 | 166 | 171 | 177 |
| 29 | 117 | 123 | 128 | 133 | 139 | 144 | 149 | 155 | 160 | 165 | 171 |
| 30 | 113 | 119 | 124 | 129 | 134 | 139 | 144 | 150 | 155 | 160 | 165 |
| 31 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 | 155 | 160 |
| 32 | 106 | 111 | 116 | 121 | 126 | 130 | 135 | 140 | 145 | 150 | 155 |
| 33 | 103 | 108 | 112 | 117 | 122 | 127 | 131 | 136 | 141 | 145 | 150 |
| 34 | 100 | 105 | 109 | 114 | 118 | 123 | 127 | 132 | 137 | 141 | 146 |
| 35 | 97 | 102 | 106 | 110 | 115 | 119 | 124 | 128 | 133 | 137 | 142 |
| 36 | 95 | 99 | 103 | 107 | 112 | 116 | 120 | 125 | 129 | 133 | 138 |
| 37 | 92 | 96 | 100 | 104 | 109 | 113 | 117 | 121 | 125 | 130 | 134 |
| 38 | 90 | 94 | 98 | 102 | 106 | 110 | 114 | 118 | 122 | 126 | 130 |
| 39 | 87 | 91 | 95 | 99 | 103 | 107 | 111 | 115 | 119 | 123 | 127 |
| Weight per Ft. in Pounds. | 195.5 | 202.2 | 209.0 | 215.8 | 222.6 | 229.4 | 236.2 | 243.1 | 249.8 | 256.7 | 263.4 |
| Section Modulus. | 340.5 | 355.8 | 371.2 | 386.6 | 402.1 | 417.5 | 433.0 | 448.6 | 464.2 | 479.8 | 495.4 |
| *Coefficient of Deflection.* | 0.000000223 | | | 0.000000198 | | | 0.000000170 | | | 0.000000154 | |

# SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

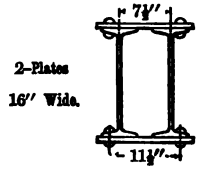
**Safe loads below are figured for fiber stress of 15 000 pounds per square inch, with $\frac{3}{4}$″ rivet holes in both flanges deducted, and include weight of girder.**




| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾″ Use Two Plates. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ¾ | 13/16 | ⅞ | 15/16 | 1 | 1 1/16 | 1 ⅛ | 1 3/16 | 1 ¼ | 1 5/16 | 1 ⅜ |
| 15 | 275 | 286 | 297 | 308 | 320 | 331 | 343 | 354 | 365 | 377 | 388 |
| 16 | 257 | 268 | 279 | 289 | 300 | 310 | 321 | 332 | 343 | 350 | 364 |
| 17 | 242 | 252 | 262 | 272 | 282 | 292 | 302 | 312 | 322 | 333 | 343 |
| 18 | 229 | 238 | 248 | 257 | 266 | 276 | 285 | 295 | 305 | 314 | 324 |
| 19 | 217 | 226 | 235 | 244 | 252 | 261 | 270 | 280 | 288 | 298 | 307 |
| 20 | 206 | 214 | 223 | 231 | 240 | 248 | 257 | 266 | 274 | 283 | 291 |
| 21 | 196 | 204 | 212 | 220 | 228 | 237 | 245 | 253 | 261 | 269 | 277 |
| 22 | 187 | 195 | 203 | 210 | 218 | 226 | 234 | 241 | 249 | 257 | 265 |
| 23 | 179 | 186 | 194 | 201 | 209 | 216 | 223 | 231 | 238 | 246 | 253 |
| 24 | 172 | 179 | 186 | 193 | 200 | 207 | 214 | 221 | 228 | 236 | 243 |
| 25 | 165 | 171 | 178 | 185 | 192 | 199 | 206 | 212 | 219 | 226 | 233 |
| 26 | 158 | 165 | 171 | 178 | 184 | 191 | 198 | 204 | 211 | 217 | 224 |
| 27 | 153 | 159 | 165 | 171 | 178 | 184 | 190 | 197 | 203 | 209 | 216 |
| 28 | 147 | 153 | 159 | 165 | 171 | 177 | 184 | 190 | 196 | 202 | 208 |
| 29 | 142 | 148 | 154 | 160 | 165 | 171 | 177 | 183 | 189 | 195 | 201 |
| 30 | 137 | 143 | 149 | 154 | 160 | 166 | 171 | 177 | 183 | 188 | 194 |
| 31 | 133 | 138 | 144 | 149 | 155 | 160 | 166 | 171 | 177 | 182 | 188 |
| 32 | 129 | 134 | 139 | 145 | 150 | 155 | 161 | 166 | 171 | 177 | 182 |
| 33 | 125 | 130 | 135 | 140 | 145 | 151 | 156 | 161 | 166 | 171 | 177 |
| 34 | 121 | 126 | 131 | 136 | 141 | 146 | 151 | 156 | 161 | 166 | 171 |
| 35 | 118 | 122 | 127 | 132 | 137 | 142 | 147 | 152 | 157 | 162 | 166 |
| 36 | 114 | 119 | 124 | 129 | 133 | 138 | 143 | 148 | 152 | 157 | 162 |
| 37 | 111 | 116 | 120 | 125 | 130 | 134 | 139 | 144 | 148 | 153 | 157 |
| 38 | 108 | 113 | 117 | 122 | 126 | 131 | 135 | 140 | 144 | 149 | 153 |
| 39 | 106 | 110 | 114 | 119 | 123 | 127 | 132 | 136 | 141 | 145 | 149 |
| Weight per Ft. in Pounds. | 215.5 | 222.2 | 229.0 | 235.8 | 242.6 | 249.4 | 256.2 | 263.1 | 269.8 | 276.7 | 283.4 |
| Section Modulus. | 411.8 | 428.7 | 445.7 | 462.7 | 479.7 | 496.7 | 513.8 | 531.2 | 548.1 | 565.3 | 582.5 |
| Coefficient of Deflection. | 0.000000168 | | | 0.000000147 | | | 0.0000001131 | | | 0.0000001119 | |

# SAFE LOADS IN THOUSANDS OF POUND UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

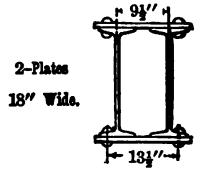
Safe loads below are figured for fiber stress of 15 000 pounds per square incl 1⅛" rivet holes in both flanges deducted, and include weight of girder.




| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾" Use Two Plates. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ¾ | 13/16 | ⅞ | 15/16 | 1 | 1 1/16 | 1 ⅛ | 1 3/16 | 1 ¼ | 1 5/16 |
| 15 | 309 | 320 | 331 | 343 | 354 | 365 | 376 | 387 | 399 | 410 |
| 16 | 290 | 300 | 311 | 321 | 332 | 342 | 353 | 363 | 374 | 384 |
| 17 | 273 | 283 | 292 | 302 | 312 | 322 | 332 | 342 | 352 | 362 |
| 18 | 258 | 267 | 276 | 285 | 295 | 304 | 313 | 323 | 332 | 342 |
| 19 | 244 | 253 | 262 | 270 | 279 | 288 | 297 | 306 | 315 | 324 |
| 20 | 232 | 240 | 249 | 257 | 265 | 274 | 282 | 291 | 299 | 307 |
| 21 | 221 | 229 | 237 | 245 | 253 | 261 | 269 | 277 | 285 | 293 |
| 22 | 211 | 218 | 226 | 234 | 241 | 249 | 256 | 264 | 272 | 279 |
| 23 | 202 | 209 | 216 | 223 | 231 | 238 | 245 | 253 | 260 | 267 |
| 24 | 193 | 200 | 207 | 214 | 221 | 228 | 235 | 243 | 249 | 256 |
| 25 | 186 | 192 | 199 | 206 | 212 | 219 | 226 | 232 | 239 | 246 |
| 26 | 178 | 185 | 191 | 198 | 204 | 211 | 217 | 224 | 230 | 236 |
| 27 | 172 | 178 | 184 | 190 | 196 | 203 | 209 | 215 | 221 | 228 |
| 28 | 166 | 172 | 178 | 184 | 189 | 195 | 201 | 208 | 214 | 220 |
| 29 | 160 | 166 | 171 | 177 | 183 | 189 | 195 | 200 | 206 | 212 |
| 30 | 155 | 160 | 166 | 171 | 177 | 182 | 188 | 194 | 199 | 205 |
| 31 | 150 | 155 | 160 | 166 | 171 | 177 | 182 | 187 | 193 | 198 |
| 32 | 145 | 150 | 155 | 161 | 166 | 171 | 176 | 182 | 187 | 192 |
| 33 | 141 | 146 | 151 | 156 | 161 | 166 | 171 | 176 | 181 | 186 |
| 34 | 136 | 141 | 146 | 151 | 156 | 161 | 166 | 171 | 176 | 181 |
| 35 | 133 | 137 | 142 | 147 | 152 | 156 | 161 | 166 | 171 | 176 |
| 36 | 129 | 133 | 138 | 143 | 147 | 152 | 157 | 161 | 166 | 171 |
| 37 | 125 | 130 | 134 | 139 | 143 | 148 | 152 | 157 | 162 | 166 |
| 38 | 122 | 126 | 131 | 135 | 140 | 144 | 148 | 153 | 157 | 162 |
| 39 | 119 | 123 | 127 | 132 | 136 | 140 | 145 | 149 | 153 | 158 |
| Weight per Ft. in Pounds. | 245.5 | 252.2 | 259.0 | 265.8 | 272.6 | 279.4 | 286.2 | 293.1 | 299.8 | 306.7 |
| Section Modulus | 463.8 | 480.4 | 497.1 | 513.8 | 530.6 | 547.3 | 564.1 | 581.2 | 597.8 | 614.7 |
| Coefficient of *Deflection.* | 0.000000149 | | | 0.0000000133 | | | 0.000000119 | | | 0.000 |

# SAFE LOADS IN THOUSANDS OF POUNDS UNIFORMLY DISTRIBUTED FOR BEAM BOX GIRDERS.

**Safe loads below are figured for fiber stress of 15 000 pounds per square inch, with " rivet holes in both flanges deducted, and include weight of girder.**




| Distance Center to Center of Bearings in Feet. | Thickness of Plates in Inches. For Thicknesses Greater than ¾" Use Two Plates. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ¾ | 13/16 | ⅞ | 15/16 | 1 | 1 1/16 | 1 ⅛ | 1 3/16 | 1 ¼ | 1 5/16 | 1 ⅜ |
| 15 | 396 | 411 | 427 | 442 | 458 | 473 | 489 | 505 | 520 | 536 | 551 |
| 16 | 371 | 386 | 400 | 415 | 429 | 444 | 458 | 473 | 488 | 502 | 517 |
| 17 | 349 | 363 | 377 | 390 | 404 | 418 | 431 | 445 | 459 | 473 | 487 |
| 18 | 330 | 343 | 356 | 369 | 381 | 394 | 407 | 421 | 433 | 446 | 460 |
| 19 | 312 | 325 | 337 | 349 | 361 | 374 | 386 | 398 | 411 | 423 | 435 |
| 20 | 297 | 308 | 320 | 332 | 343 | 355 | 367 | 379 | 390 | 402 | 414 |
| 21 | 283 | 294 | 305 | 316 | 327 | 338 | 349 | 361 | 372 | 383 | 394 |
| 22 | 270 | 280 | 291 | 302 | 312 | 323 | 333 | 344 | 355 | 365 | 376 |
| 23 | 258 | 268 | 278 | 288 | 299 | 309 | 319 | 329 | 339 | 349 | 360 |
| 24 | 247 | 257 | 267 | 276 | 286 | 296 | 306 | 315 | 325 | 335 | 345 |
| 25 | 237 | 247 | 256 | 265 | 275 | 284 | 293 | 303 | 312 | 321 | 331 |
| 26 | 228 | 237 | 246 | 255 | 264 | 273 | 282 | 291 | 300 | 309 | 318 |
| 27 | 220 | 228 | 237 | 246 | 254 | 263 | 272 | 280 | 289 | 298 | 306 |
| 28 | 212 | 220 | 229 | 237 | 245 | 254 | 262 | 270 | 279 | 287 | 295 |
| 29 | 205 | 213 | 221 | 229 | 237 | 245 | 253 | 261 | 269 | 277 | 285 |
| 30 | 198 | 206 | 213 | 221 | 229 | 237 | 244 | 252 | 260 | 268 | 276 |
| 31 | 192 | 199 | 206 | 214 | 222 | 229 | 237 | 244 | 252 | 259 | 267 |
| 32 | 186 | 193 | 200 | 207 | 215 | 222 | 229 | 237 | 244 | 251 | 258 |
| 33 | 180 | 187 | 194 | 201 | 208 | 215 | 222 | 229 | 236 | 244 | 251 |
| 34 | 175 | 181 | 188 | 195 | 202 | 209 | 216 | 223 | 229 | 236 | 243 |
| 35 | 170 | 176 | 183 | 190 | 196 | 203 | 210 | 216 | 223 | 230 | 236 |
| 36 | 165 | 171 | 178 | 184 | 191 | 197 | 204 | 210 | 217 | 223 | 230 |
| 37 | 160 | 167 | 173 | 179 | 186 | 192 | 198 | 205 | 211 | 217 | 224 |
| 38 | 156 | 162 | 168 | 175 | 181 | 187 | 193 | 199 | 205 | 211 | 218 |
| 39 | 152 | 158 | 164 | 170 | 176 | 182 | 188 | 194 | 200 | 206 | 212 |
| Weight per Ft. in Pounds. | 255.7 | 263.3 | 271.0 | 278.6 | 286.2 | 293.9 | 301.5 | 309.2 | 316.8 | 324.5 | 332.1 |
| Section Modulus. | 593.7 | 616.9 | 640.1 | 663.4 | 686.7 | 710.0 | 733.3 | 757.1 | 780.2 | 803.6 | 827.1 |
| Coefficient of Deflection. | 0.0000000983 | | | 0.0000000870 | | | 0.0000000778 | | | 0.0000000713 | |

# SAFE UNIFORMLY DISTRIBUTED LOADS FO PLATE GIRDERS IN THOUSANDS OF POUNDS.

The safe loads below include the weight of the girder and are calculated f fiber stress of 15 000 pounds per square inch on the net section. The net sectio obtained by deducting holes figured at 7/8 of an inch in diameter (for 3/4" rivets) f both flanges.

Web Plate 24" × 3/8" — Flange Angles 5" × 3 1/2"

Web Plate 27" × 3/8" — Flange An 5" × 3 1/

| Distance Center to Center of Bearings. | Thickness of Flange Angles in Inches. | | | | Thickness of Flang Angles in Inches. | | | |
|---|---|---|---|---|---|---|---|---|
| | 3/8 | 1/2 | 5/8 | 3/4 | 3/8 | 1/2 | 5/8 | 3/ |
| 25 | 59 | 74 | 87 | | 69 | 85 | 101 | |
| 26 | 57 | 71 | 84 | | 67 | 82 | 97 | |
| 27 | 55 | 68 | 81 | 92 | 64 | 79 | 93 | |
| 28 | 53 | 66 | 78 | 89 | 62 | 76 | 90 | 10 |
| 29 | 51 | 63 | 75 | 86 | 60 | 74 | 87 | 9 |
| 30 | 50 | 61 | 73 | 83 | 58 | 71 | 84 | 9 |
| 31 | 48 | 59 | 70 | 80 | 56 | 69 | 81 | 9 |
| 32 | 46 | 57 | 68 | 78 | 54 | 67 | 79 | 9 |
| 33 | 45 | 56 | 66 | 75 | 53 | 65 | 76 | 8 |
| 34 | 44 | 54 | 64 | 73 | 51 | 63 | 74 | 8 |
| 35 | 42 | 53 | 62 | 71 | 50 | 61 | 72 | 8 |
| 36 | 41 | 51 | 60 | 69 | 48 | 59 | 70 | 8 |
| 37 | 40 | 50 | 59 | 67 | 47 | 58 | 68 | 7 |
| 38 | 39 | 48 | 57 | 66 | 46 | 56 | 66 | 7 |
| 39 | 38 | 47 | 56 | 64 | 44 | 55 | 65 | 7 |
| 40 | 37 | 46 | 54 | 62 | 43 | 53 | 63 | 7 |
| 41 | 36 | 45 | 53 | 61 | 42 | 52 | 61 | 7 |
| 42 | 35 | 44 | 52 | 59 | 41 | 51 | 60 | 6 |
| 43 | 35 | 43 | 51 | 58 | 40 | 50 | 59 | 6 |
| 44 | 34 | 42 | 49 | 57 | 39 | 49 | 57 | 6 |
| 45 | 33 | 41 | 48 | 55 | 39 | 47 | 56 | 6 |
| 46 | 32 | 40 | 47 | 54 | 38 | 46 | 55 | 6 |
| 47 | 32 | 39 | 46 | 53 | 37 | 45 | 54 | 6 |
| 48 | 31 | 38 | 45 | 52 | 36 | 44 | 53 | 6 |
| 49 | 30 | 38 | 44 | 51 | 35 | 44 | 51 | 5 |
| 50 | 30 | 37 | 44 | 50 | 35 | 43 | 50 | 5 |
| 51 | 29 | 36 | 43 | 49 | 34 | 42 | 49 | 5 |
| 52 | 29 | 35 | 42 | 48 | 33 | 41 | 48 | 5 |
| 53 | 28 | 35 | 41 | 47 | 33 | 40 | 48 | 5 |
| 54 | 28 | 34 | 40 | 46 | 32 | 40 | 47 | 5 |
| Weight per *Foot in Pounds.* | 74.1 | 86.9 | 99.3 | 111.7 | 78 | 90.8 | 103.2 | 11 |

## 'E UNIFORMLY DISTRIBUTED LOADS FOR PLATE GIRDERS IN THOUSANDS OF POUNDS.

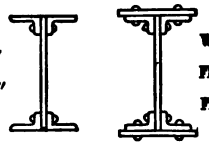
afe loads below include the weight of the girder and are calculated for a ress of 15 000 pounds per square inch on the net section. The net section is d by deducting holes figured at ⅞ of an inch in diameter (for ¾″ rivets) from nges.

| Web Plate 0″ × ⅜″ | | Flange Angles 5″ × 3½″ | Web Plate 33″ × ⅜″ | | Flange Angles 5″ × 3½″ |
|---|---|---|---|---|---|

| ce to of | Thickness of Flange Angles in Inches. | | | | Thickness of Flange Angles in Inches. | | | |
|---|---|---|---|---|---|---|---|---|
| | ⅜ | ½ | ⅝ | ¾ | ⅜ | ½ | ⅝ | ¾ |
| | 74 | 91 | 108 | | 83 | 103 | 122 | |
| | 71 | 88 | 105 | | 81 | 100 | 118 | |
| | 69 | 86 | 101 | 116 | 78 | 97 | 114 | 131 |
| | 67 | 83 | 98 | 113 | 76 | 94 | 111 | 127 |
| | 65 | 81 | 95 | 109 | 74 | 91 | 107 | 123 |
| | 63 | 78 | 93 | 106 | 72 | 88 | 104 | 119 |
| | 61 | 76 | 90 | 103 | 70 | 86 | 101 | 116 |
| | 60 | 74 | 88 | 101 | 68 | 84 | 99 | 113 |
| | 58 | 72 | 85 | 98 | 66 | 81 | 96 | 110 |
| | 57 | 70 | 83 | 95 | 64 | 79 | 94 | 107 |
| | 55 | 69 | 81 | 93 | 63 | 77 | 91 | 104 |
| | 54 | 67 | 79 | 91 | 61 | 75 | 89 | 102 |
| | 53 | 65 | 77 | 89 | 60 | 74 | 87 | 99 |
| | 51 | 64 | 75 | 86 | 58 | 72 | 85 | 97 |
| | 50 | 62 | 74 | 85 | 57 | 70 | 83 | 95 |
| | 49 | 61 | 72 | 83 | 56 | 69 | 81 | 93 |
| | 48 | 60 | 71 | 81 | 54 | 67 | 79 | 91 |
| | 47 | 58 | 69 | 79 | 53 | 66 | 78 | 89 |
| | 46 | 57 | 68 | 77 | 52 | 64 | 76 | 87 |
| | 45 | 56 | 66 | 76 | 51 | 63 | 75 | 85 |
| | 44 | 55 | 65 | 74 | 50 | 62 | 73 | 84 |
| | 43 | 54 | 64 | 73 | 49 | 61 | 72 | 82 |
| | 43 | 53 | 62 | 72 | 48 | 59 | 70 | 80 |
| | 42 | 52 | 61 | 70 | 47 | 58 | 69 | 79 |
| | 41 | 51 | 60 | 69 | 46 | 57 | 68 | 77 |
| | 40 | 50 | 59 | 68 | 46 | 56 | 66 | 76 |
| | 39 | 49 | 58 | 66 | 45 | 55 | 65 | 75 |
| | 39 | 48 | 57 | 65 | 44 | 54 | 64 | 73 |
| | 38 | 47 | 56 | 64 | 43 | 53 | 63 | 72 |
| | 37 | 46 | 55 | 63 | 42 | 52 | 62 | 71 |
| per in. | 86.6 | 101.4 | 115.8 | 129.4 | 90.4 | 105.2 | 119.6 | 133.2 |

## SAFE UNIFORMLY DISTRIBUTED LOAD PLATE GIRDERS IN THOUSANDS O POUNDS.

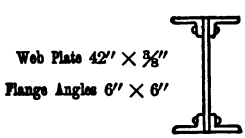
The safe loads below include the weight of the girder and are calc fiber stress of 15 000 pounds per square inch on the net section. The n obtained by deducting holes figured at ⅞ of an inch in diameter (for ¾″ both flanges.

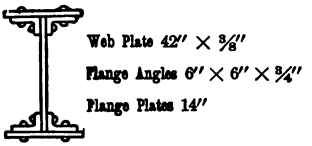



| Distance Center to Center of Bearings. | Thickness of Flange Angles in Inches. | | | | Thickness of Plate in Inc | | |
|---|---|---|---|---|---|---|---|
| | ⅜ | ½ | ⅝ | ¾ | ½ | ⅝ | ¾ |
| 30 | 108 | 134 | 159 | 183 | 238 | 255 | |
| 31 | 104 | 130 | 154 | 177 | 230 | 247 | 264 |
| 32 | 101 | 125 | 149 | 171 | 223 | 239 | 256 |
| 33 | 98 | 122 | 144 | 166 | 216 | 232 | 248 |
| 34 | 95 | 118 | 140 | 161 | 210 | 225 | 241 |
| 35 | 92 | 115 | 136 | 157 | 204 | 219 | 234 |
| 36 | 90 | 112 | 132 | 152 | 198 | 213 | 227 |
| 37 | 87 | 109 | 129 | 148 | 193 | 207 | 221 |
| 38 | 85 | 106 | 125 | 144 | 188 | 201 | 215 |
| 39 | 83 | 103 | 122 | 141 | 183 | 196 | 210 |
| 40 | 81 | 100 | 119 | 137 | 178 | 191 | 205 |
| 41 | 79 | 98 | 116 | 134 | 174 | 187 | 200 |
| 42 | 77 | 96 | 113 | 131 | 170 | 182 | 195 |
| 43 | 75 | 93 | 111 | 128 | 166 | 178 | 190 |
| 44 | 74 | 91 | 108 | 125 | 162 | 174 | 186 |
| 45 | 72 | 89 | 106 | 122 | 158 | 170 | 182 |
| 46 | 70 | 87 | 104 | 119 | 155 | 166 | 178 |
| 47 | 69 | 85 | 101 | 117 | 152 | 163 | 174 |
| 48 | 67 | 84 | 99 | 114 | 149 | 160 | 171 |
| 49 | 66 | 82 | 97 | 112 | 146 | 156 | 167 |
| 50 | 65 | 80 | 95 | 110 | 143 | 153 | 164 |
| 51 | 63 | 79 | 93 | 108 | 140 | 150 | 160 |
| 52 | 62 | 77 | 92 | 106 | 137 | 147 | 157 |
| 53 | 61 | 76 | 90 | 104 | 135 | 144 | 154 |
| 54 | 60 | 74 | 88 | 102 | 132 | 142 | 152 |
| 55 | 59 | 73 | 87 | 100 | 130 | 139 | 149 |
| 56 | 58 | 72 | 85 | 98 | 127 | 137 | 146 |
| 57 | 57 | 70 | 84 | 96 | 125 | 134 | 144 |
| 58 | 56 | 69 | 82 | 95 | 123 | 132 | 141 |
| 59 | 55 | 68 | 81 | 93 | 121 | 130 | 139 |
| Weight per *Foot in Pounds.* | 107.1 | 126.3 | 144.7 | 162.7 | 214.1 | 226 | 287.9 |

# SAFE UNIFORMLY DISTRIBUTED LOADS FOR PLATE GIRDERS IN THOUSANDS OF POUNDS.

**The safe loads below include the weight of the girder and are calculated for a fiber stress of 15 000 pounds per square inch on the net section. The net section is obtained by deducting holes figured at one inch in diameter (for ⅞″ rivets) from both flanges.**

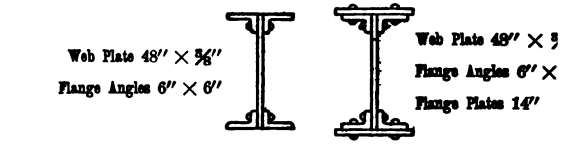



| Distance Center to Center of Bearings. | Thickness of Flange Angles in Inches. | | | Thickness of Flange Plate in Inches. | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | ½ | ⅝ | ¾ | ½ | ⅝ | ¾ | ⅞ | 1 | 1¼ |
| **35** | 139 | 164 | 189 | 240 | 257 | 275 | 292 | 309 | |
| **36** | 135 | 160 | 184 | 234 | 250 | 267 | 284 | 301 | |
| **37** | 131 | 155 | 179 | 227 | 244 | 260 | 276 | 293 | |
| **38** | 128 | 151 | 174 | 221 | 237 | 253 | 269 | 285 | |
| **39** | 125 | 148 | 169 | 216 | 231 | 247 | 260 | 278 | 309 |
| **40** | 122 | 144 | 165 | 210 | 225 | 240 | 256 | 271 | 301 |
| **41** | 119 | 140 | 161 | 205 | 220 | 235 | 249 | 264 | 294 |
| **42** | 116 | 137 | 157 | 200 | 215 | 229 | 243 | 258 | 287 |
| **43** | 113 | 134 | 154 | 195 | 210 | 224 | 238 | 252 | 280 |
| **44** | 111 | 131 | 150 | 191 | 205 | 219 | 232 | 246 | 274 |
| **45** | 108 | 128 | 147 | 187 | 200 | 214 | 227 | 241 | 268 |
| **46** | 106 | 125 | 144 | 183 | 196 | 209 | 222 | 235 | 262 |
| **47** | 103 | 122 | 141 | 179 | 192 | 205 | 217 | 230 | 256 |
| **48** | 101 | 120 | 138 | 175 | 188 | 200 | 213 | 226 | 251 |
| **49** | 99 | 117 | 135 | 172 | 184 | 196 | 209 | 221 | 246 |
| **50** | 97 | 115 | 132 | 168 | 180 | 192 | 204 | 217 | 241 |
| **51** | 95 | 113 | 130 | 165 | 177 | 189 | 200 | 212 | 236 |
| **52** | 94 | 111 | 127 | 162 | 173 | 185 | 197 | 208 | 232 |
| **53** | 92 | 109 | 125 | 159 | 170 | 181 | 193 | 204 | 227 |
| **54** | 90 | 107 | 122 | 156 | 167 | 178 | 189 | 201 | 223 |
| **55** | 88 | 105 | 120 | 153 | 164 | 175 | 186 | 197 | 219 |
| **56** | 87 | 103 | 118 | 150 | 161 | 172 | 183 | 193 | 215 |
| **57** | 85 | 101 | 116 | 147 | 158 | 169 | 179 | 190 | 211 |
| **58** | 84 | 99 | 114 | 145 | 155 | 166 | 176 | 187 | 208 |
| **59** | 82 | 98 | 112 | 142 | 153 | 163 | 173 | 184 | 204 |
| **60** | 81 | 96 | 110 | 140 | 150 | 160 | 170 | 180 | 201 |
| **61** | 80 | 94 | 108 | 138 | 148 | 158 | 168 | 178 | 197 |
| **62** | 78 | 93 | 107 | 136 | 145 | 155 | 165 | 175 | 194 |
| **63** | 77 | 91 | 105 | 133 | 143 | 153 | 162 | 172 | 191 |
| **64** | 76 | 90 | 103 | 131 | 141 | 150 | 160 | 169 | 188 |
| **Weight per Foot in Pounds.** | 134.9 | 153.3 | 171.3 | 224.7 | 236.6 | 248.5 | 260.4 | 272.3 | 296.1 |

# SAFE UNIFORMLY DISTRIBUTED LOADS PLATE GIRDERS IN THOUSANDS OF POUNDS.

The safe loads below include the weight of the girder and are calcu fiber stress of 15 000 pounds per square inch on the net section. The re obtained by deducting holes figured at one inch in diameter (for ¾" rivets flanges.




| Distance Center to Center of Bearings. | Thickness of Flange Angles in Inches. | | | Thickness of Flange in Inches. | | | |
|---|---|---|---|---|---|---|---|
| | ½ | ⅝ | ¾ | ½ | ⅝ | ¾ | ⅞ |
| 35 | 166 | 195 | 224 | 283 | 303 | 322 | 342 |
| 36 | 161 | 190 | 218 | 275 | 294 | 313 | 333 |
| 37 | 157 | 185 | 212 | 267 | 286 | 305 | 324 |
| 38 | 153 | 180 | 206 | 260 | 279 | 297 | 315 |
| 39 | 149 | 175 | 201 | 254 | 272 | 289 | 307 |
| 40 | 145 | 171 | 196 | 247 | 265 | 282 | 299 |
| 41 | 141 | 167 | 191 | 241 | 258 | 275 | 292 |
| 42 | 138 | 163 | 187 | 236 | 252 | 269 | 285 |
| 43 | 135 | 159 | 182 | 230 | 246 | 263 | 279 |
| 44 | 132 | 155 | 178 | 225 | 241 | 256 | 272 |
| 45 | 129 | 152 | 174 | 220 | 235 | 251 | 266 |
| 46 | 126 | 149 | 170 | 215 | 230 | 245 | 260 |
| 47 | 123 | 145 | 167 | 211 | 225 | 240 | 255 |
| 48 | 121 | 142 | 163 | 206 | 221 | 235 | 249 |
| 49 | 118 | 140 | 160 | 202 | 216 | 230 | 244 |
| 50 | 116 | 137 | 157 | 198 | 212 | 226 | 240 |
| 51 | 114 | 134 | 154 | 194 | 208 | 221 | 235 |
| 52 | 112 | 131 | 151 | 190 | 204 | 217 | 230 |
| 53 | 109 | 129 | 148 | 187 | 200 | 213 | 226 |
| 54 | 107 | 127 | 145 | 183 | 196 | 209 | 222 |
| 55 | 105 | 124 | 142 | 180 | 193 | 205 | 218 |
| 56 | 104 | 122 | 140 | 177 | 189 | 201 | 214 |
| 57 | 102 | 120 | 137 | 174 | 186 | 198 | 210 |
| 58 | 100 | 118 | 135 | 171 | 183 | 195 | 206 |
| 59 | 98 | 116 | 133 | 168 | 179 | 191 | 203 |
| 60 | 97 | 114 | 131 | 165 | 176 | 188 | 200 |
| 61 | 95 | 112 | 128 | 162 | 174 | 185 | 196 |
| 62 | 94 | 110 | 126 | 160 | 171 | 182 | 193 |
| 63 | 92 | 109 | 124 | 157 | 168 | 179 | 190 |
| 64 | 91 | 107 | 122 | 155 | 165 | 176 | 187 |
| Weight per *Foot in Pounds.* | 142.5 | 160.9 | 178.9 | 232.3 | 244.2 | 256.2 | 268 |

## GRILLAGE BEAMS FOR FOUNDATIONS.

In designing foundations for walls or columns carrying heavy loads resting upon the soil, it is necessary to distribute the weight over a suitable area, and this is readily accomplished, in a small depth, by using a grillage composed of steel beams imbedded in concrete, thus obviating the necessity of large masses of masonry and deep excavations. For heavy loads on soil of small bearing power three tiers of beams may be necessary, while for lighter loads and soil of greater bearing power two tiers of beams will ordinarily suffice.

The grillage beams which are to be surrounded by concrete should be spaced not less than 3″ apart in the clear between the flanges, so that the concrete may be thoroughly rammed between them and gas-pipe, or standard cast-iron separators should be used to maintain the beams in proper position.

Knowing the total weight to be carried and the allowable intensity of loading per square foot of the supporting soil, the area of the footing required can be readily found, which taken into consideration with any other conditions limiting the form or proportions of the footing, will determine the external dimensions of the foundation. The beams may be considered as subjected to a uniform load extending over a portion of their upper surfaces, the centre of which is at the centre of length of the beams, and as being uniformly supported from below throughout their length.

Under these circumstances, the maximum bending moment will occur at the centre of the beam and, using the notation given for the upper tier in the sketch below, this bending moment for one beam will be as follows:

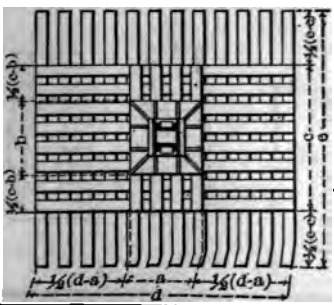
$$\text{Bending moment in inch pounds} = \frac{W}{8}(c - b)$$

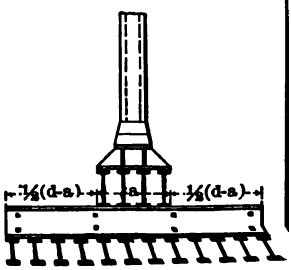
in which c and b are expressed in inches and W is the total weight in pounds on one beam, obtained by dividing the total load by the number of beams composing the tier in question.

This formula for the bending moment is the same as that for a beam of the length (c — b) supported at the ends and uniformly loaded with the total weight W, so that the proper sizes of beams, bending considered, may be obtained directly from the tables of safe loads uniformly distributed for Cambria I-beams, on pages 77 to 87 inclusive, or for cases in which the lengths are shorter than those given in these tables, the sizes may be calculated from the coefficients of strength or the section moduli given in the tables of properties of I-beams, pages 160 to 163 inclusive, taking care, however, to use as the length, the distance (c — b), for the upper tier, and the corresponding figures for the other tiers.

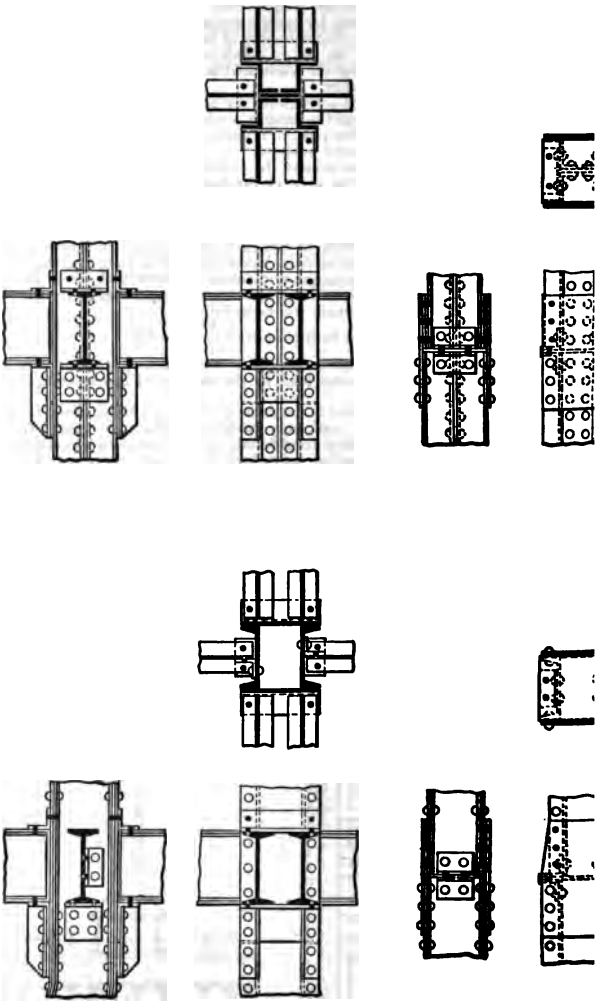
After determining the size of beam required based upon bending, as stated above, an examination should also be made of the capacity of the beam web to resist buckling. This may be done by considering the web as a column of height equal to the clear distance between the fillets and calculating the safe load therefor by the use of the tables of strength for steel columns or struts, on pages 194 and 197, using the proper safety factor.

If the beam web is found insufficient as a column when calculated in this manner, a beam with a web of greater thickness should be tried until one is found that will meet this requirement and the conditions for bending; or it might be more economical, in some cases, to use the beam with the thinner web and provide it with sufficient separators, fitting between the beam flanges, or stiffeners secured to the web to assist it in resisting as a column.

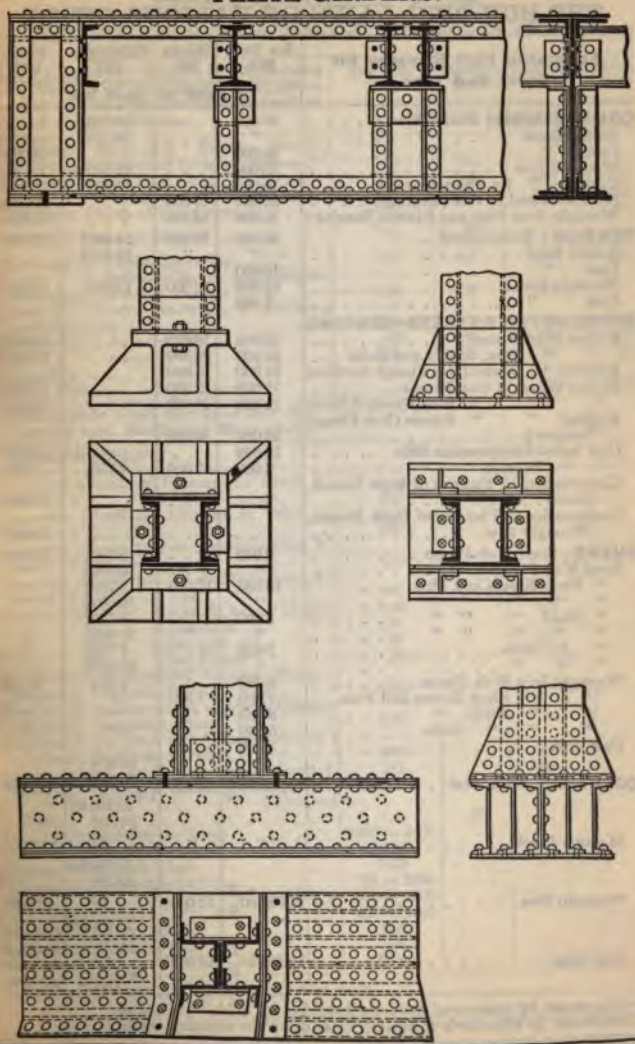


## TYPICAL DETAILS FOR STEEL COLUMNS.



# TYPICAL DETAILS OF COLUMN BASES AND PLATE GIRDERS.



# ALLOWABLE UNIT STRESSES AND LOADS IN ACCORDANCE WITH THE BUILDING LAWS OF VARIOUS CITIES.

| Allowable Unit Stresses for Steel and Iron. | New York. 1900. | Chicago. 1898. | Philadelphia. 1899. | Boston. 1898. |
|---|---|---|---|---|
| | Pounds per Square Inch. | | | |
| **COMPRESSION**: Rolled Steel | 16 000 | . . . | 14 500‡ | . . . |
| Rolled Steel | " | . . . | 16 250‖ | . . . |
| Cast " | 16 000 | . . . | . . . | 8 000 |
| Wrought Iron | 12 000 | . . . | 12 500 | . . . |
| Cast " (in Short Blocks) | 16 000 | . . . | 17 500 | . . . |
| Steel Pins and Rivets (Bearing) | 20 000 | 20 000 | . . . | 18 000 |
| Wrought Iron Pins and Rivets (Bearing) | 15 000 | 15 000 | . . . | 15 000 |
| **TENSION**: Rolled Steel | 16 000 | 15 000 | 14 500‡ | 15 000 |
| Rolled Steel | " | " | 16 250‖ | . . . |
| Cast " | 16 000 | . . . | . . . | . . . |
| Wrought Iron | 12 000 | 12 000 | 12 500 | 12 000 |
| Cast " | 3 000 | . . . | . . . | . . . |
| **EXTREME FIBER STRESS—BENDING** | | | | |
| Rolled Steel Beams | 16 000 | 16 000 | . . . | 16 000 |
| " " Pins, Rivets and Bolts | 20 000 | 22 500 | . . . | 22 500 |
| Riveted " Beams (Net Flange Section) | 14 000 | 15 000 | . . . | . . . |
| Rolled Wrought Iron Beams | 12 000 | 12 000 | . . . | 12 000 |
| " " " Pins, Rivets & Bolts | 15 000 | 18 000 | . . . | 18 000 |
| Riveted " " Beams (Net Flange Section) | 12 000 | 10 000 | . . . | . . . |
| Cast Iron—Compression Side | 16 000 | . . . | . . . | 8 000 |
| " " Tension " | 3 000 | 2 500 | 3 750 | 2 500 |
| Compression in Flanges of Built Beams, Steel | . . . | . . . | . . . | 12 000 |
| Compression in Flanges of Built Beams, Wrought Iron | . . . | . . . | . . . | 10 000 |
| **SHEAR**: Steel Web Plates | 9 000 | . . . | 8 750‡ | 10 000 |
| Steel Web Plates | " | . . . | 10 000‖ | " |
| " Shop Rivets and Pins | 10 800 | 10 000 | 8 750‡ | " |
| " " " " " | " | " | 10 000‖ | " |
| " Field " " " | 8 000 | " | 8 750‡ | " |
| " " " " " | " | " | 10 000‖ | " |
| " " Bolts | 7 000 | . . . | 8 750‡ | " |
| " " " | " | . . . | 10 000‖ | " |
| Wrought Iron Web Plates | 6 000 | . . . | 7 500 | 9 000 |
| " " Shop Rivets and Pins | 7 500 | 7 500 | " | " |
| " " Field " | 6 000 | " | " | " |
| " " " Bolts | 5 500 | . . . | " | " |
| Cast Iron | 3 000 | . . . | . . . | . . . |
| **COLUMNS**: Mild Steel | $15\,200\text{-}58\frac{L}{R}$ | 15 000* | $\frac{14\,500}{1+\frac{L^2}{13\,500R^2}}$ | 12 000* |
| Medium Steel | " | " | $\frac{16\,250}{1+\frac{L^2}{11\,000R^2}}$ | " |
| Wrought Iron | $14\,000\text{-}80\frac{L}{R}$ | 12 000* | $\frac{12\,500}{1+\frac{L^2}{15\,000D^2}}$ | 10 000* |
| Cast Iron | $11\,300\text{-}30\frac{L}{R}$ | 10 000† | $\frac{17\,500}{1+\frac{L^2}{400D^2}}$ | See Section 19 of Boston Building Laws |

* *Reduced* by approved modern formulæ. ‡ Mild. ‖ Medium.
† *Reduced by* Gordon's formula. Reduced for eccentric loads.

# LOWABLE UNIT STRESSES AND LOADS IN ACCORDANCE WITH E BUILDING LAWS OF VARIOUS CITIES.

| ads for Floors in Different ses of Buildings, Exclusive ıe Weight of the Materials onstruction. | New York. 1900. | Chicago. 1898. | Philadelphia. 1899. | Boston. 1899. |
|---|---|---|---|---|
| | Pounds per Square Foot. | | | |
| s, Apartment Houses, Hotels, ent Houses or Lodging Houses. . | 60 | 40 | 70 | 50 |
| ildings—First Floor . . . . . | 150 | 100 | 100 | 100 |
| " above First Floor . . . . | 75 | 100 | 100 | 100 |
| r Places of Instruction . . . . . | 75 | . . . | . . . | 80 |
| Carriage Houses . . . . . | 75 | 40* / 100† | . . . | . . . |
| for Public Assembly . . | 90 | 100 | 120 | 150 |
| " Ordinary Stores, Light Manu- ıg and Light Storage . . . . | 120 | 100 | 120 | . . . |
| r Heavy Materials, Warehouses ctories . . . . . | 150 | . . . | 150 | 250 |
| itch less than 20°. . . . . | 50 | 25 | 30 | 25‡ |
| " more " 20°. . . . . | 30 | 25 | 30 | 25‡ |
| s . . . . . | 300 | . . . | . . . | . . . |
| uildings, except Schools . . | . . . | . . . | . . . | 150 |
| **ıble Unit Stresses for Ma- and Building Materials.** | | | | |
| **RESSION.** | Pounds per Square Inch. | | | |
| (Portland) Cement, 1; Sand, 2; . . . . . | 230 | 55 | 208 | . . . |
| (Portland) Cement, 1; Sand, 2; . . . . . | 208 | " | " | . . . |
| (Rosendale or equal) Cement, 1; ; Stone, 4 . . . . . | 125 | " | " | . . . |
| (Rosendale or equal) Cement, 1; ; Stone, 5 . . . . . | 111 | " | " | . . . |
| onework, Portland Cement Mortar | 140 | . . . | 139 | . . . |
| " Rosendale " " | 111 | . . . | " | . . . |
| " Lime and " " | 97 | . . . | 111 | . . . |
| " Lime Mortar . | 70 | . . . | 69½ | . . . |
| k in Portland Cement Mortar; t, 1: Sand, 3 . . . . . | 250 | . . . | 208 | . . . |
| k in Rosendale, or equal, Cement ; Cement, 1; Sand, 3. . . . . | 208 | . . . | " | . . . |
| k in Lime and Cement Mortar; t, 1; Lime, 1; Sand, 6 . . . . | 160 | . . . | 167 | . . . |
| k in Lime Mortar; Lime, 1; Sand, 4. | 111 | . . . | 111 | . . . |
| n Stones in Cement Mortar . . . | . . . | 70 | . . . | . . . |
| " " " , Dressed . . . . . | . . . | 97 | . . . | . . . |
| (according to Test) . . . . . | 1000 to 2400 | . . . | . . . | . . . |
| h Stone . . . . . | 1200 | . . . | . . . | . . . |
| lew York City) . . . . . | 1300 | . . . | . . . | . . . |
| e (according to Test) . . . . . | 700 to 2300 | . . . | . . . | . . . |
| { " " " " } . . . . . | 600 to 1200 | . . . | . . . | . . . |
| e { " " " " } . . . . . | 400 to 1600 | . . . | . . . | . . . |
| (North River) . . . . . | 2000 | . . . | . . . | . . . |
| averstraw, Flatwise) . . . . . | 300 | . . . | . . . | . . . |
| . . . . . | 1000 | . . . | . . . | . . . |

bles less than 500 Square Feet in Area.
" *over* 500 " " " "
*ke proper allowance for* Wind at 30 lbs. per Square Foot Horizontal.

# ALLOWABLE UNIT STRESSES AND LOADS IN ACCORDANCE WITH THE BUILDING LAWS OF VARIOUS CITIES.

| Allowable Unit Stresses for Masonry. | New York. 1900. | Chicago. 1898. | Philadelphia. 1898. | Boston. 1898. |
|---|---|---|---|---|
| **EXTREME FIBRE STRESS—BENDING** | Pounds per Square Inch. | | | |
| Granite | 180 | . . . | . . . . | . . . |
| Greenwich Stone | 150 | . . . | . . . . | . . . |
| Gneiss (New York City) | 150 | . . . | . . . . | . . . |
| Limestone | 150 | . . . | . . . . | . . . |
| Slate | 400 | . . . | . . . . | . . . |
| Marble | 120 | . . . | . . . . | . . . |
| Sandstone | 100 | . . . | . . . . | . . . |
| Bluestone—North River | 390 | . . . | . . . . | . . . |
| Concrete (Portland) Cement, 1; Sand, 2; Stone, 4 | 30 | . . . | . . . . | . . . |
| Concrete (Portland) Cement, 1; Sand, 2; Stone, 5 | 20 | . . . | . . . . | . . . |
| Concrete (Rosendale or equal) Cement, 1; Sand, 2; Stone, 4. | 16 | . . . | . . . . | . . . |
| Concrete (Rosendale or equal) Cement, 1; Sand, 2; Stone, 5 | 10 | . . . | . . . . | . . . |
| Brick (Common) | 50 | . . . | . . . . | . . . |
| Brickwork (in Cement) | 30 | . . . | . . . . | . . . |
| **Allowable Unit Stresses for Timber.** | | | | |
| **COMPRESSION:** | | | | |
| Oak, with Grain | 900 | . . . | . . . . | . . . |
| " across " | 800 | . . . | . . . . | 250 |
| Yellow Pine, with Grain | 1000 | . . . | 750 | . . . |
| " " across " | 600 | . . . | 91⅔ | 250 |
| White " with " | 800 | . . . | . . . . | . . . |
| " " across " | 400 | . . . | . . . . | 150 |
| Spruce, with Grain | 800 | . . . | 500 | . . . |
| " across " | 400 | . . . | 50 | 150 |
| Locust, with " | 1200 | . . . | . . . . | . . . |
| " across " | 1000 | . . . | . . . . | . . . |
| Hemlock, with " | 500 | . . . | 350 | . . . |
| " across " | 500 | . . . | 41⅔ | . . . |
| Chestnut, with " | 500 | . . . | . . . . | . . . |
| " across " | 1000 | . . . | . . . . | . . . |
| **TENSION:** | | | | |
| Yellow Pine | 1200 | . . . | 1800 | . . . |
| White " | 800 | . . . | . . . . | . . . |
| *Spruce* | 800 | . . . | 1250 | . . . |
| *Oak* | 1000 | . . . | 1000 | . . . |
| *Hemlock* | 600 | . . . | . . . . | . . . |

# ALLOWABLE UNIT STRESSES AND LOADS IN ACCORDANCE WITH THE BUILDING LAWS OF VARIOUS CITIES.

| Allowable Unit Stresses for Timber. | New York. 1900. | Chicago 1898. | Philadelphia. 1899. | Boston. 1899. |
|---|---|---|---|---|
| **EXTREME FIBER STRESS—BENDING:** | Pounds Per Square Inch. | | | |
| Yellow Pine | 1200 | 1250 | 1600 | 1250 |
| White " | 800 | 750 | . . . . | 750 |
| Spruce | 800 | 750 | 1100 | 750 |
| Oak | 1000 | 1000 | . . . . | 1000 |
| Locust | 1200 | . . . | . . . . | . . . |
| Hemlock | 600 | . . . | 900 | . . . |
| Chestnut | 800 | . . . | . . . . | . . . |
| **Wooden Columns or Posts with Flat Ends.** | | | | |
| Yellow Pine (Long Leaf) | $1000-18\frac{L}{D}$ | . . . | $\frac{U}{6}-\frac{6\times L^*}{100D}$ | . . . |
| White Pine, Norway Pine and Spruce | $800-15\frac{L}{D}$ | . . . | " | . . . |
| Oak | $900-17\frac{L}{D}$ | . . . | " | . . . |
| Chestnut and Hemlock | $\frac{5}{8}(800-15\frac{L}{D})$ | . . . | " | . . . |
| Locust | $1\frac{1}{2}($ " $)$ | . . . | " | . . . |
| **SHEAR:** Yellow Pine, with Fiber | 70 | 100 | $66\frac{2}{3}$ | 100 |
| Yellow Pine, across fiber | 500 | 250 | 750 | |
| White " with " | 40 | 80 | . . . . | 80 |
| " " across " | 250 | 150 | . . . . | |
| Spruce, with Fiber | 50 | 80 | 50 | 80 |
| " across " | 320 | 150 | 500 | |
| Oak, with " | 100 | 150 | . . . . | 150 |
| " across " | 600 | 250 | . . . . | . . . |
| Locust with " | 100 | . . . | . . . . | . . . |
| " across " | 720 | . . . | . . . . | . . . |
| Hemlock, with " | 40 | . . . | $41\frac{2}{3}$ | . . . |
| " across " | 275 | . . . | $416\frac{2}{3}$ | . . . |
| Chestnut, " " | 150 | . . . | . . . . | . . . |

* $\frac{U}{6}$ = Allowable Compression in Lbs. per Sq. Inch and $\frac{L}{D}$ = Ratio of Length to Diameter in Inches.

## Allowable Unit Stresses for Timber Columns in Accordance with the Building Laws of Boston and Chicago.

### For Posts with Flat Ends.

The Stresses given in the following table, in which L = Length of Post, D = Least Diameter of Post, and S = Stress per Square Inch.

| White Pine and Spruce. | | Long-Leafed Yellow Pine. | | White Oak. |
|---|---|---|---|---|
| $\frac{L}{D}$ | S | $\frac{L}{D}$ | S | S |
| 0 to 10 | 625 | 0 to 15 | 1000 | 750 |
| 10 " 35 | 500 | 15 " 30 | 875 | 650 |
| 35 " 45 | 375 | 30 " 40 | 750 | 560 |
| 45 " 50 | 250 | 40 " 45 | 625 | 470 |
| | | 45 " 50 | 500 | 375 |

For information not given in these tables, see Complete Building Laws of the Various Cities.

# EXPLANATION OF TABLES OF RIVETS AND PINS.

## Rivets.

In the design of riveted joints the total stress transmitted is as to be taken up by the rivets, no allowance being made for the fr between the plates riveted together, and the manner of failure joint will be by shearing of the rivet or crushing of the plate. assumes that the rules given on page 278 are followed and failu tearing off the plate caused by the rivets being too near the e thus prevented.

In the table of "Shearing Value of Rivets and Bearing Va Riveted Plates," pages 272 and 273, these values are given for a tomary sizes and thicknesses corresponding to various usual allo unit stresses.

For any given size of rivet or thickness of plate to be used, spection of the table will show at once if the bearing value of th or the shearing value of the rivet is to govern the design a amount of stress that can be transmitted by each rivet.

## Pins.

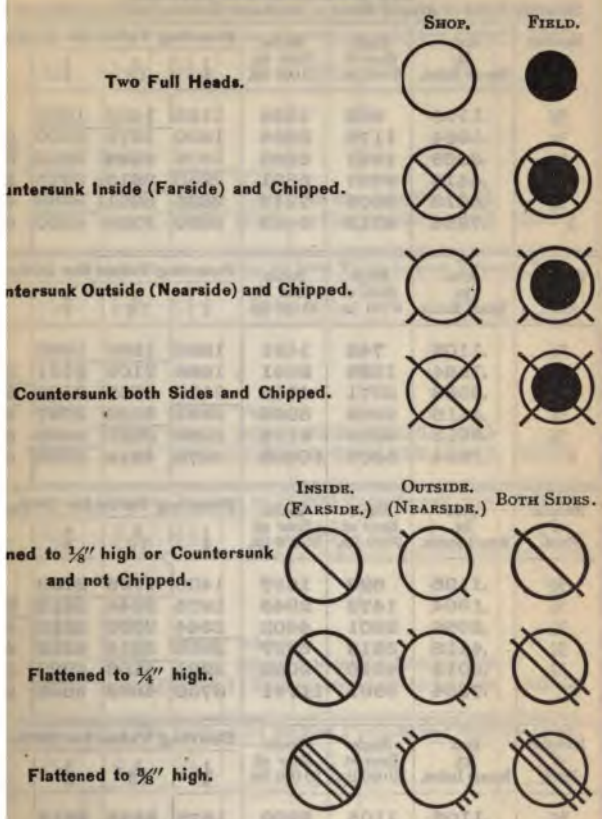
In designing pin-connected joints the points which govern the are the bending moments produced in the pin by the bars or connected, and the bearing value of the plates themselves. Th ing value in the case of eye-bars of proper proportions is suffi ample and need not be computed. Shear in pins need not ord be considered, as the bending and bearing stresses usually det the size.

In the table of "Maximum Bending Moments on Pins," pag and 275, is given the allowable bending moments on pins of v diameters for the usual allowable fibre stresses.

In the table of "Bearing Values of Pin Plates for One-Inch ness of Plate," on page 279, is given the allowable bearing va plates against pins of various usual diameters, corresponding customary unit stresses of this character.

If the bearing value exceeds the allowable limit in any giv -in-plates must be added, thus increasing the bearing value unt *iced to a safe* limit as shown by the tables.

## CONVENTIONAL SIGNS FOR RIVETING.




his system, designed by F. C. Osborn, C.E., has for foundation the diagonal o represent a countersink, the blackened circle for a field rivet and the diagonal to indicate a flattened head. The position of the cross, with respect to the (inside, outside or both sides), indicates the location of the countersink and ly the number and position of the diagonal strokes indicate the height and n of the flattened heads.

ny combination of field, countersunk and flattened head rivets liable to occur e *readily indicated by the* proper combination of above signs.

# SHEARING VALUE OF RIVETS AND BEARING VALUE OF RIVETED PLATES.

## ALL DIMENSIONS IN INCHES.

Shearing Value = Area of Rivet × Allowable Shearing Stress per Square Inch.

| Diameter of Rivet. | Area in Square Inches. | Single Shear at 6 000 lbs. | Double Shear at 12 000 lbs. | Bearing Value for Different | | | |
|---|---|---|---|---|---|---|---|
| | | | | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{7}{16}$ |
| $\frac{5}{8}$ | .1105 | 663 | 1325 | 1125 | 1406 | 1688 | |
| $\frac{1}{2}$ | .1964 | 1178 | 2356 | 1500 | 1875 | 2250 | 2625 |
| $\frac{5}{8}$ | .3068 | 1841 | 3682 | 1875 | 2344 | 2813 | 3281 |
| $\frac{3}{4}$ | .4418 | 2651 | 5301 | 2250 | 2813 | 3375 | 3938 |
| $\frac{7}{8}$ | .6013 | 3608 | 7216 | 2625 | 3281 | 3938 | 4594 |
| 1 | .7854 | 4712 | 9425 | 3000 | 3750 | 4500 | 5250 |

| Diameter of Rivet. | Area in Square Inches. | Single Shear at 6 750 lbs. | Double Shear at 13 500 lbs. | Bearing Value for Different | | | |
|---|---|---|---|---|---|---|---|
| | | | | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{7}{16}$ |
| $\frac{5}{8}$ | .1105 | 746 | 1491 | 1266 | 1582 | 1898 | |
| $\frac{1}{2}$ | .1964 | 1325 | 2651 | 1688 | 2109 | 2531 | 2953 |
| $\frac{5}{8}$ | .3068 | 2071 | 4142 | 2109 | 2637 | 3164 | 3691 |
| $\frac{3}{4}$ | .4418 | 2982 | 5964 | 2531 | 3164 | 3797 | 4430 |
| $\frac{7}{8}$ | .6013 | 4059 | 8118 | 2953 | 3691 | 4430 | 5168 |
| 1 | .7854 | 5301 | 10603 | 3375 | 4219 | 5063 | 5906 |

| Diameter of Rivet. | Area in Square Inches. | Single Shear at 7 500 lbs. | Double Shear at 15 000 lbs. | Bearing Value for Different | | | |
|---|---|---|---|---|---|---|---|
| | | | | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{7}{16}$ |
| $\frac{5}{8}$ | .1105 | 828 | 1657 | 1406 | 1758 | 2109 | |
| $\frac{1}{2}$ | .1964 | 1473 | 2945 | 1875 | 2344 | 2813 | 3281 |
| $\frac{5}{8}$ | .3068 | 2301 | 4602 | 2344 | 2930 | 3516 | 4102 |
| $\frac{3}{4}$ | .4418 | 3313 | 6627 | 2813 | 3516 | 4219 | 4922 |
| $\frac{7}{8}$ | .6013 | 4510 | 9020 | 3281 | 4102 | 4922 | 5742 |
| 1 | .7854 | 5891 | 11781 | 3750 | 4688 | 5625 | 6563 |

| Diameter of Rivet. | Area in Square Inches. | Single Shear at 10 000 lbs. | Double Shear at 20 000 lbs. | Bearing Value for Different | | | |
|---|---|---|---|---|---|---|---|
| | | | | $\frac{1}{4}$ | $\frac{5}{16}$ | $\frac{3}{8}$ | $\frac{7}{16}$ |
| $\frac{5}{8}$ | .1105 | 1105 | 2209 | 1875 | 2344 | 2813 | |
| $\frac{1}{2}$ | .1964 | 1964 | 3927 | 2500 | 3125 | 3750 | 4375 |
| $\frac{5}{8}$ | .3068 | 3068 | 6136 | 3125 | 3906 | 4688 | 5469 |
| $\frac{3}{4}$ | .4418 | 4418 | 8836 | 3750 | 4688 | 5625 | 6563 |
| $\frac{7}{8}$ | .6013 | 6013 | 12026 | 4375 | 5469 | 6563 | 7656 |
| 1 | .7854 | 7854 | 15708 | 5000 | 6250 | 7500 | 8750 |

In the above tables the bearing values between the lower and upper zigzag black lines are greater than single and less than double shear for the corresponding dimensions, so that in case of single shear the single shearing value governs, and in case of double shear, the bearing value governs the design.

# EARING VALUE OF RIVETS AND BEARING VALUE OF RIVETED PLATES.

## ALL DIMENSIONS IN INCHES.

ng Value = Diameter of Rivet × Thickness of Plate × Allowable Bearing Stress per Square Inch.

**cknesses of Plate in Inches at 12 000 Pounds per Square Inch.**

| 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
|---|---|---|---|---|---|---|---|---|
| 000 | | | | | | | | |
| 750 | 4219 | 4688 | | | | | | |
| 500 | 5063 | 5625 | 6188 | 6750 | | | | |
| 250 | 5906 | 6563 | 7219 | 7875 | 8531 | 9188 | 9844 | |
| 000 | 6750 | 7500 | 8250 | 9000 | 9750 | 10500 | 11250 | 12000 |

**cknesses of Plate in Inches at 13 500 Pounds per Square Inch.**

| 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
|---|---|---|---|---|---|---|---|---|
| 375 | | | | | | | | |
| 219 | 4746 | 5273 | | | | | | |
| 063 | 5695 | 6328 | 6961 | 7594 | | | | |
| 906 | 6645 | 7383 | 8121 | 8859 | 9598 | 10336 | 11074 | |
| 750 | 7594 | 8438 | 9281 | 10125 | 10969 | 11813 | 12656 | 13500 |

**cknesses of Plate in Inches at 15 000 Pounds per Square Inch.**

| 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
|---|---|---|---|---|---|---|---|---|
| 750 | | | | | | | | |
| 688 | 5273 | 5859 | | | | | | |
| 625 | 6328 | 7031 | 7734 | 8438 | | | | |
| 563 | 7383 | 8203 | 9023 | 9844 | 10664 | 11484 | 12305 | |
| 500 | 8438 | 9375 | 10313 | 11250 | 12188 | 13125 | 14063 | 15000 |

**cknesses of Plate in Inches at 20 000 Pounds per Square Inch.**

| 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 | 1 |
|---|---|---|---|---|---|---|---|---|
| 000 | | | | | | | | |
| 250 | 7031 | 7813 | | | | | | |
| 500 | 8438 | 9375 | 10313 | 11250 | | | | |
| 750 | 9844 | 10938 | 12031 | 13125 | 14219 | 15313 | 16406 | |
| 000 | 11250 | 12500 | 13750 | 15000 | 16250 | 17500 | 18750 | 20000 |

ie bearing values above and to the right of the upper zigzag black lines are ter than double shear for the corresponding dimensions, so that in these cases hearing values *govern the design.*

*e bearing values below and to the left of the lower zigzag black lines are less single shear, so that in these cases* the bearing values govern the design.

# MAXIMUM BENDING MOMENTS ON PINS WITH EXTREME FIBRE STRESSES

## VARYING FROM 15 000 TO 25 000 POUNDS PER SQUARE INCH.

| Diameter of Pin in Inches. | Area of Pin in Square Inches. | Moments in Inch-Pounds for Fibre Stresses of | | | | |
|---|---|---|---|---|---|---|
| | | 15 000 Lbs. per Square Inch. | 18 000 Lbs. per Square Inch. | 20 000 Lbs. per Square Inch. | 22 500 Lbs. per Square Inch. | 25 000 Lbs. per Square Inch. |
| 1 | .785 | 1470 | 1770 | 1960 | 2210 | 2450 |
| 1 1/8 | .994 | 2100 | 2520 | 2800 | 3150 | 3490 |
| 1 1/4 | 1.227 | 2900 | 3450 | 3830 | 4310 | 4790 |
| 1 3/8 | 1.485 | 3830 | 4590 | 5100 | 5740 | 6380 |
| 1 1/2 | 1.767 | 4970 | 5960 | 6630 | 7460 | 8280 |
| 1 5/8 | 2.074 | 6320 | 7580 | 8430 | 9480 | 10530 |
| 1 3/4 | 2.405 | 7890 | 9470 | 10520 | 11840 | 13150 |
| 1 7/8 | 2.761 | 9710 | 11650 | 12940 | 14560 | 16180 |
| 2 | 3.142 | 11780 | 14140 | 15710 | 17670 | 19630 |
| 2 1/8 | 3.547 | 14130 | 16960 | 18840 | 21200 | 23550 |
| 2 1/4 | 3.976 | 16770 | 20130 | 22370 | 25160 | 27960 |
| 2 3/8 | 4.430 | 19730 | 23670 | 26300 | 29590 | 32880 |
| 2 1/2 | 4.909 | 23010 | 27610 | 30680 | 34510 | 38350 |
| 2 5/8 | 5.412 | 26640 | 31960 | 35520 | 39960 | 44400 |
| 2 3/4 | 5.940 | 30630 | 36750 | 40830 | 45940 | 51040 |
| 2 7/8 | 6.492 | 34990 | 41990 | 46660 | 52490 | 58320 |
| 3 | 7.069 | 39730 | 47680 | 52970 | 59600 | 66220 |
| 3 1/8 | 7.670 | 44940 | 53930 | 59920 | 67410 | 74900 |
| 3 1/4 | 8.296 | 50550 | 60660 | 67400 | 75830 | 84250 |
| 3 3/8 | 8.946 | 56610 | 67940 | 75480 | 84920 | 94350 |
| 3 1/2 | 9.621 | 63140 | 75770 | 84180 | 94710 | 105220 |
| 3 5/8 | 10.321 | 70150 | 84180 | 93530 | 105220 | 116910 |
| 3 3/4 | 11.045 | 77660 | 93190 | 103540 | 116490 | 129430 |
| 3 7/8 | 11.793 | 85690 | 102820 | 114250 | 128530 | 142810 |
| 4 | 12.566 | 94250 | 113100 | 125660 | 141370 | 157080 |
| 4 1/8 | 13.364 | 103360 | 124040 | 137820 | 155040 | 172270 |
| 4 1/4 | 14.186 | 113050 | 135660 | 150730 | 169570 | 188410 |
| 4 3/8 | 15.033 | 123320 | 147980 | 164420 | 184980 | 205530 |
| 4 1/2 | 15.904 | 134190 | 161030 | 178920 | 201290 | 223650 |
| 4 5/8 | 16.800 | 145690 | 174830 | 194250 | 218510 | 242810 |
| 4 3/4 | 17.721 | 157820 | 189390 | 210430 | 236740 | 263040 |
| 4 7/8 | 18.665 | 170580 | 204740 | 227490 | 255920 | 284360 |
| 5 | 19.635 | 184080 | 220890 | 245440 | 276120 | 306800 |
| 5 1/8 | 20.629 | 198230 | 237880 | 264310 | 297350 | 330390 |
| 5 1/4 | 21.648 | 213090 | 255710 | 284120 | 319640 | 355160 |
| 5 3/8 | 22.691 | 228680 | 274420 | 304910 | 343020 | 381130 |
| 5 1/2 | 23.758 | 245010 | 294010 | 326680 | 367510 | 408350 |
| 5 5/8 | 24.850 | 262100 | 314510 | 349460 | 393140 | 436880 |
| 5 3/4 | 25.967 | 279960 | 335950 | 373280 | 419940 | 466600 |
| 5 7/8 | 27.109 | 298620 | 358340 | 398160 | 447980 | 497700 |

# MAXIMUM BENDING MOMENTS ON PINS W
## EXTREME FIBRE STRESSES

### VARYING FROM 15 000 TO 25 000 POUNDS PER SQUARE IN

| Diameter of Pin in Inches. | Area of Pin in Square Inches. | Moments in Inch-Pounds for Fib Stresses of | | | | |
|---|---|---|---|---|---|---|
| | | 15 000 Lbs. per Square Inch. | 18 000 Lbs. per Square Inch. | 20 000 Lbs. per Square Inch. | 22 500 Lbs. per Square Inch. | 25 0 Squa |
| 6 | 28.274 | 318090 | 381700 | 424120 | 477130 | 5 |
| 6 1/8 | 29.465 | 338380 | 406060 | 451180 | 507580 | 5 |
| 6 1/4 | 30.680 | 359530 | 431430 | 479370 | 539290 | 5 |
| 6 3/8 | 31.919 | 381530 | 457840 | 508710 | 572300 | 6 |
| 6 1/2 | 33.183 | 404420 | 485400 | 539230 | 606630 | 6 |
| 6 5/8 | 34.472 | 428200 | 513840 | 570940 | 642300 | 7 |
| 6 3/4 | 35.785 | 452900 | 543480 | 603870 | 679350 | 7 |
| 6 7/8 | 37.122 | 478530 | 574240 | 638040 | 717800 | 7 |
| 7 | 38.485 | 505110 | 606130 | 673480 | 757660 | 8 |
| 7 1/8 | 39.871 | 532650 | 639190 | 710210 | 798980 | 8 |
| 7 1/4 | 41.282 | 561180 | 673420 | 748250 | 841780 | 9 |
| 7 3/8 | 42.718 | 590710 | 708860 | 787620 | 886070 | 9 |
| 7 1/2 | 44.179 | 621260 | 745510 | 828350 | 931890 | 10 |
| 7 5/8 | 45.664 | 652850 | 783410 | 870460 | 979270 | 10 |
| 7 3/4 | 47.173 | 685480 | 822580 | 913980 | 1028220 | 11 |
| 7 7/8 | 48.707 | 719190 | 863030 | 958920 | 1078780 | 11 |
| 8 | 50.265 | 753980 | 904780 | 1005310 | 1130970 | 12 |
| 8 1/8 | 51.849 | 789880 | 947860 | 1053170 | 1184820 | 13 |
| 8 1/4 | 53.456 | 826900 | 992280 | 1102530 | 1240350 | 13 |
| 8 3/8 | 55.088 | 865060 | 1038070 | 1153410 | 1297590 | 14 |
| 8 1/2 | 56.745 | 904370 | 1085250 | 1205830 | 1356560 | 15 |
| 8 5/8 | 58.426 | 944860 | 1133830 | 1259820 | 1417290 | 15 |
| 8 3/4 | 60.132 | 986540 | 1183850 | 1315390 | 1479810 | 16 |
| 8 7/8 | 61.862 | 1029430 | 1235310 | 1372570 | 1544140 | 17 |
| 9 | 63.617 | 1078540 | 1288250 | 1431390 | 1610310 | 17 |
| 9 1/8 | 65.397 | 1118900 | 1342680 | 1491860 | 1678340 | 18 |
| 9 1/4 | 67.201 | 1165510 | 1398610 | 1554010 | 1748270 | 19 |
| 9 3/8 | 69.029 | 1213400 | 1456080 | 1617870 | 1820100 | 20 |
| 9 1/2 | 70.882 | 1262590 | 1515110 | 1683450 | 1893880 | 21 |
| 9 5/8 | 72.760 | 1313090 | 1575700 | 1750780 | 1969630 | 21 |
| 9 3/4 | 74.662 | 1364910 | 1637900 | 1819880 | 2047370 | 22 |
| 9 7/8 | 76.590 | 1418090 | 1701700 | 1890780 | 2127130 | 23 |
| 10 | 78.540 | 1472620 | 1767150 | 1963500 | 2208930 | 24 |
| 10 1/4 | 82.516 | 1585850 | 1903020 | 2114470 | 2378780 | 26 |
| 10 1/2 | 86.590 | 1704740 | 2045690 | 2272990 | 2557120 | 28 |
| 10 3/4 | 90.763 | 1829430 | 2195320 | 2439250 | 2744150 | 30 |
| 11 | 95.033 | 1960060 | 2352070 | 2613410 | 2940090 | 32 |
| 11 1/4 | 99.402 | 2096760 | 2516110 | 2795680 | 3145140 | 34 |
| 11 1/2 | 103.869 | 2239670 | 2687610 | 2986230 | 3359510 | 3 |
| 12 | *113.098* | *2544690* | 3053630 | 3392920 | 3817040 | |

# RIVETS.

## TABLES OF AREAS IN SQUARE INCHES, TO BE DEDUCTED RIVETED PLATES OR SHAPES TO OBTAIN NET AREAS

| Thickness Plates in Inches. | SIZE OF HOLE. Inches. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ¼ | 5/16 | 3/8 | 7/16 | ½ | 9/16 | 5/8 | 11/16 | ¾ | 13/16 | ⅞ | 15/16 |
| 1/4 | .06 | .08 | .09 | .11 | .13 | .14 | .16 | .17 | .19 | .20 | .22 | .23 |
| 5/16 | .08 | .10 | .12 | .14 | .16 | .18 | .20 | .21 | .23 | .25 | .27 | .29 |
| 3/8 | .09 | .12 | .14 | .16 | .19 | .21 | .23 | .26 | .28 | .30 | .33 | .35 |
| 7/16 | .11 | .14 | .16 | .19 | .22 | .25 | .27 | .30 | .33 | .36 | .38 | .41 |
| 1/2 | .13 | .16 | .19 | .22 | .25 | .28 | .31 | .34 | .38 | .41 | .44 | .47 |
| 9/16 | .14 | .18 | .21 | .25 | .28 | .32 | .35 | .39 | .42 | .46 | .49 | .53 |
| 5/8 | .16 | .20 | .23 | .27 | .31 | .35 | .39 | .43 | .47 | .51 | .55 | .59 |
| 11/16 | .17 | .21 | .26 | .30 | .34 | .39 | .43 | .47 | .52 | .56 | .60 | .64 |
| 3/4 | .19 | .23 | .28 | .33 | .38 | .42 | .47 | .52 | .56 | .61 | .66 | .70 |
| 13/16 | .20 | .25 | .30 | .36 | .41 | .46 | .51 | .56 | .61 | .66 | .71 | .76 |
| 7/8 | .22 | .27 | .33 | .38 | .44 | .49 | .55 | .60 | .66 | .71 | .77 | .82 |
| 15/16 | .23 | .29 | .35 | .41 | .47 | .53 | .59 | .64 | .70 | .76 | .82 | .88 |
| 1 | .25 | .31 | .38 | .44 | .50 | .56 | .63 | .69 | .75 | .81 | .88 | .94 |
| 1 1/16 | .27 | .33 | .40 | .46 | .53 | .60 | .66 | .73 | .80 | .86 | .93 | 1.00 |
| 1 1/8 | .28 | .35 | .42 | .49 | .56 | .63 | .70 | .77 | .84 | .91 | .98 | 1.05 |
| 1 3/16 | .30 | .37 | .45 | .52 | .59 | .67 | .74 | .82 | .89 | .96 | 1.04 | 1.11 |
| 1 1/4 | .31 | .39 | .47 | .55 | .63 | .70 | .78 | .86 | .94 | 1.02 | 1.09 | 1.17 |
| 1 5/16 | .33 | .41 | .49 | .57 | .66 | .74 | .82 | .90 | .98 | 1.07 | 1.15 | 1.23 |
| 1 3/8 | .34 | .43 | .52 | .60 | .69 | .77 | .86 | .95 | 1.03 | 1.12 | 1.20 | 1.29 |
| 1 7/16 | .36 | .45 | .54 | .63 | .72 | .81 | .90 | .99 | 1.08 | 1.17 | 1.26 | 1.35 |
| 1 1/2 | .38 | .47 | .56 | .66 | .75 | .84 | .94 | 1.03 | 1.13 | 1.22 | 1.31 | 1.41 |
| 1 9/16 | .39 | .49 | .59 | .68 | .78 | .88 | .98 | 1.07 | 1.17 | 1.27 | 1.37 | 1.46 |
| 1 5/8 | .41 | .51 | .61 | .71 | .81 | .91 | 1.02 | 1.12 | 1.22 | 1.32 | 1.42 | 1.52 |
| 1 11/16 | .42 | .53 | .63 | .74 | .84 | .95 | 1.05 | 1.16 | 1.27 | 1.37 | 1.47 | 1.58 |
| 1 3/4 | .44 | .55 | .66 | .77 | .88 | .98 | 1.09 | 1.20 | 1.31 | 1.42 | 1.53 | 1.64 |
| 1 13/16 | .45 | .57 | .68 | .79 | .91 | 1.02 | 1.13 | 1.25 | 1.36 | 1.47 | 1.59 | 1.70 |
| 1 7/8 | .47 | .59 | .70 | .82 | .94 | 1.05 | 1.17 | 1.29 | 1.41 | 1.52 | 1.64 | 1.76 |
| 1 15/16 | .48 | .61 | .73 | .85 | .97 | 1.09 | 1.21 | 1.33 | 1.45 | 1.57 | 1.70 | 1.82 |
| 2 | .50 | .63 | .75 | .88 | 1.00 | 1.13 | 1.25 | 1.38 | 1.50 | 1.63 | 1.75 | 1.88 |

# MAXIMUM SIZE OF RIVETS IN BEAMS CHANNELS AND ANGLES.

| I-BEAMS. | | | | | | CHANNELS. | | | ANGLE | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth of Beam. Inch's | Weight per Foot. Pounds. | Size of Rivet. Inches. | Depth of Beam Inchs | Weight per Foot. Pounds. | Size of Rivet. Inches. | Depth of Channel Inches. | Weight per Foot. Pounds. | Size of Rivet. Inches. | Len'th of Leg. Inches | Size of Rivet. Inches. | Le |
| 3 | 5.5 | 3/4 | 15 | 42.0 | 3/4 | 3 | 4.0 | 3/4 | 3/4 | 1/4 | 2 |
| 4 | 7.5 | 1/2 | 15 | 60.0 | 7/8 | 4 | 5.25 | 1/2 | 1 | 5/16 | 2 |
| 5 | 9.75 | 1/2 | 15 | 80.0 | 7/8 | 5 | 6.50 | 1/2 | 1 1/4 | 3/8 | 3 |
| 6 | 12.25 | 5/8 | 18 | 55.0 | 7/8 | 6 | 8.0 | 5/8 | 1 1/2 | 3/8 | 3 |
| 7 | 15.0 | 5/8 | 20 | 65.0 | 1 | 7 | 9.75 | 5/8 | 1 3/4 | 1/2 | 4 |
| 8 | 17.75 | 5/8 | 20 | 80.0 | 1 | 8 | 11.25 | 5/8 | 1 1/2 | 1/2 | 4 |
| 9 | 21.0 | 3/4 | 24 | 80.0 | 1 | 9 | 13.25 | 3/4 | 1 3/4 | 5/8 | 5 |
| 10 | 25.0 | 3/4 | | | | 10 | 15.0 | 3/4 | 2 | 5/8 | 6 |
| 12 | 31.5 | 3/4 | | | | 12 | 20.50 | 3/4 | 2 1/4 | 5/8 | 7 |
| 12 | 40.0 | 3/4 | | | | 15 | 33.0 | 3/4 | 2 1/2 | 3/4 | |

# RIVETS.

## TABLES OF AREAS IN SQUARE INCHES, TO BE DEDUCTED FROM RIVETED PLATES OR SHAPES TO OBTAIN NET AREAS.

| SIZE OF HOLE. Inches. | | | | | | | | | | | | | | Thickness Plates. in inches. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/8 | 15/16 | 1 1/4 | 1 5/16 | 1 3/8 | 1 7/16 | 1 1/2 | 1 9/16 | 1 5/8 | 1 11/16 | 1 3/4 | 1 13/16 | 1 7/8 | 1 15/16 | 2 | |
| .28 | .30 | .31 | .33 | .34 | .36 | .38 | .39 | .41 | .42 | .44 | .45 | .47 | .48 | .50 | 1/4 |
| .35 | .37 | .39 | .41 | .43 | .45 | .47 | .49 | .51 | .53 | .55 | .57 | .59 | .61 | .63 | 5/16 |
| .42 | .45 | .47 | .49 | .52 | .54 | .56 | .59 | .61 | .63 | .66 | .68 | .70 | .73 | .75 | 3/8 |
| .49 | .52 | .55 | .57 | .60 | .63 | .66 | .68 | .71 | .74 | .77 | .79 | .82 | .85 | .88 | 7/16 |
| .56 | .59 | .63 | .66 | .69 | .72 | .75 | .78 | .81 | .84 | .88 | .91 | .94 | .97 | 1.00 | 1/2 |
| .63 | .67 | .70 | .74 | .77 | .81 | .84 | .88 | .91 | .95 | .98 | 1.02 | 1.05 | 1.09 | 1.13 | 9/16 |
| .70 | .74 | .78 | .82 | .86 | .90 | .94 | .98 | 1.02 | 1.05 | 1.09 | 1.13 | 1.17 | 1.21 | 1.25 | 5/8 |
| .77 | .82 | .86 | .90 | .95 | .99 | 1.03 | 1.07 | 1.12 | 1.16 | 1.20 | 1.25 | 1.29 | 1.33 | 1.38 | 11/16 |
| .84 | .89 | .94 | .98 | 1.03 | 1.08 | 1.13 | 1.17 | 1.22 | 1.27 | 1.31 | 1.36 | 1.41 | 1.45 | 1.50 | 3/4 |
| .91 | .96 | 1.02 | 1.07 | 1.12 | 1.17 | 1.22 | 1.27 | 1.32 | 1.37 | 1.42 | 1.47 | 1.52 | 1.57 | 1.63 | 13/16 |
| .98 | 1.04 | 1.09 | 1.15 | 1.20 | 1.26 | 1.31 | 1.37 | 1.42 | 1.48 | 1.53 | 1.59 | 1.64 | 1.70 | 1.75 | 7/8 |
| 1.05 | 1.11 | 1.17 | 1.23 | 1.29 | 1.35 | 1.41 | 1.46 | 1.52 | 1.58 | 1.64 | 1.70 | 1.76 | 1.82 | 1.88 | 15/16 |
| 1.13 | 1.19 | 1.25 | 1.31 | 1.38 | 1.44 | 1.50 | 1.56 | 1.63 | 1.69 | 1.75 | 1.81 | 1.88 | 1.94 | 2.00 | 1 |
| 1.20 | 1.26 | 1.33 | 1.39 | 1.46 | 1.53 | 1.59 | 1.66 | 1.73 | 1.79 | 1.86 | 1.93 | 1.99 | 2.06 | 2.13 | 1 1/16 |
| 1.27 | 1.34 | 1.41 | 1.48 | 1.55 | 1.62 | 1.69 | 1.76 | 1.83 | 1.90 | 1.97 | 2.04 | 2.11 | 2.18 | 2.25 | 1 1/8 |
| 1.34 | 1.41 | 1.48 | 1.56 | 1.63 | 1.71 | 1.78 | 1.86 | 1.93 | 2.00 | 2.08 | 2.15 | 2.23 | 2.30 | 2.38 | 1 3/16 |
| 1.41 | 1.48 | 1.56 | 1.64 | 1.72 | 1.80 | 1.88 | 1.95 | 2.03 | 2.11 | 2.19 | 2.27 | 2.34 | 2.42 | 2.50 | 1 1/4 |
| 1.48 | 1.56 | 1.64 | 1.72 | 1.80 | 1.89 | 1.97 | 2.05 | 2.13 | 2.21 | 2.30 | 2.38 | 2.46 | 2.54 | 2.63 | 1 5/16 |
| 1.55 | 1.63 | 1.72 | 1.80 | 1.89 | 1.98 | 2.06 | 2.15 | 2.23 | 2.32 | 2.41 | 2.49 | 2.58 | 2.66 | 2.75 | 1 3/8 |
| 1.62 | 1.71 | 1.80 | 1.89 | 1.98 | 2.07 | 2.16 | 2.25 | 2.34 | 2.43 | 2.52 | 2.61 | 2.70 | 2.79 | 2.88 | 1 7/16 |
| 1.69 | 1.78 | 1.88 | 1.97 | 2.06 | 2.16 | 2.25 | 2.34 | 2.44 | 2.53 | 2.63 | 2.72 | 2.81 | 2.91 | 3.00 | 1 1/2 |
| 1.76 | 1.86 | 1.95 | 2.05 | 2.15 | 2.25 | 2.34 | 2.44 | 2.54 | 2.64 | 2.73 | 2.83 | 2.93 | 3.03 | 3.13 | 1 9/16 |
| 1.83 | 1.93 | 2.03 | 2.13 | 2.23 | 2.34 | 2.44 | 2.54 | 2.64 | 2.74 | 2.84 | 2.95 | 3.05 | 3.15 | 3.25 | 1 5/8 |
| 1.90 | 2.00 | 2.11 | 2.21 | 2.32 | 2.43 | 2.53 | 2.64 | 2.74 | 2.85 | 2.95 | 3.06 | 3.16 | 3.27 | 3.38 | 1 11/16 |
| 1.97 | 2.08 | 2.19 | 2.30 | 2.41 | 2.52 | 2.63 | 2.73 | 2.84 | 2.95 | 3.06 | 3.17 | 3.28 | 3.39 | 3.50 | 1 3/4 |
| 2.04 | 2.15 | 2.27 | 2.38 | 2.49 | 2.61 | 2.72 | 2.83 | 2.95 | 3.06 | 3.17 | 3.29 | 3.40 | 3.51 | 3.63 | 1 13/16 |
| 2.11 | 2.23 | 2.34 | 2.46 | 2.58 | 2.70 | 2.81 | 2.93 | 3.05 | 3.16 | 3.28 | 3.40 | 3.52 | 3.63 | 3.75 | 1 7/8 |
| 2.18 | 2.30 | 2.42 | 2.54 | 2.66 | 2.79 | 2.91 | 3.03 | 3.15 | 3.27 | 3.39 | 3.51 | 3.63 | 3.75 | 3.88 | 1 15/16 |
| 2.25 | 2.38 | 2.50 | 2.63 | 2.75 | 2.88 | 3.00 | 3.13 | 3.25 | 3.38 | 3.50 | 3.63 | 3.75 | 3.88 | 4.00 | 2 |

# RIVET SPACING.

## ALL DIMENSIONS IN INCHES.

| Size of Rivet. | Minimum Pitch. | Maximum Pitch at Ends of Compression Members. | Minimum Pitch in Flanges of Chords and Gird's. | Distance from Edge of Piece to Center of Rivet Hole. | |
|---|---|---|---|---|---|
| | | | | Minimum. | Usual. |
| 1/4 | 3/4 | . . . | . . . | . . | . . |
| 5/16 | 1 1/16 | . . . | . . . | . . | . . |
| 3/8 | 1 1/8 | . . . | . . . | . . | . |
| 7/16 | 1 1/4 | . . . | . . . | . . | . |
| 1/2 | 1 3/8 | 2 1/2 | 4 | 1 1/16 | 1 1/4 |
| 9/16 | 2 1/16 | 3 | 4 | 1 1/8 | 1 1/2 |
| 5/8 | 2 1/4 | 3 1/2 | 4 | 1 3/16 | 1 3/4 |
| 7/8 | 2 5/8 | 4 | 4 | 1 1/2 | 2 |
| 1 | 3 | | | | |

*For General Rules for* Rivet Spacing see next page.

## BEARING VALUES OF PIN PLATES.

### FOR ONE INCH THICKNESS OF PLATE.

Bearing value = Diameter of Pin × 1″ × Stress per Square Inch.

| Area of Pin. | Bearing Value at 12 000 Pounds per Square Inch. | Bearing Value at 13 500 Pounds per Square Inch. | Bearing Value at 15 000 Pounds per Square Inch. | Diameter of Pin. | Area of Pin. | Bearing Value at 12 000 Pounds per Square Inch. | Bearing Value at 13 500 Pounds per Square Inch. | Bearing Value at 15 000 Pounds per Square Inch. |
|---|---|---|---|---|---|---|---|---|
| Sq. In. | Pounds. | Pounds. | Pounds. | Inches. | Sq. In. | Pounds. | Pounds. | Pounds. |
| .785 | 12000 | 13500 | 15000 | 4¼ | 15.90 | 54000 | 60750 | 67500 |
| .994 | 13500 | 15190 | 16880 | 4⅜ | 16.80 | 55500 | 62440 | 69380 |
| 1.227 | 15000 | 16880 | 18750 | 4½ | 17.72 | 57000 | 64130 | 71250 |
| 1.485 | 16500 | 18560 | 20630 | 4⅝ | 18.67 | 58500 | 65810 | 73130 |
| 1.767 | 18000 | 20250 | 22500 | 5 | 19.64 | 60000 | 67500 | 75000 |
| 2.074 | 19500 | 21940 | 24380 | 5⅛ | 20.63 | 61500 | 69190 | 76880 |
| 2.405 | 21000 | 23630 | 26250 | 5¼ | 21.65 | 63000 | 70880 | 78750 |
| 2.761 | 22500 | 25310 | 28130 | 5⅜ | 22.69 | 64500 | 72560 | 80630 |
| 3.142 | 24000 | 27000 | 30000 | 5½ | 23.76 | 66000 | 74250 | 82500 |
| 3.547 | 25500 | 28690 | 31880 | 5⅝ | 24.85 | 67500 | 75940 | 84380 |
| 3.976 | 27000 | 30380 | 33750 | 5¾ | 25.97 | 69000 | 77630 | 86250 |
| 4.430 | 28500 | 32060 | 35630 | 5⅞ | 27.11 | 70500 | 79310 | 88130 |
| 4.909 | 30000 | 33750 | 37500 | 6 | 28.27 | 72000 | 81000 | 90000 |
| 5.412 | 31500 | 35440 | 39380 | 6⅛ | 29.46 | 73500 | 82690 | 91880 |
| 5.940 | 33000 | 37130 | 41250 | 6¼ | 30.68 | 75000 | 84380 | 93750 |
| 6.492 | 34500 | 38810 | 43130 | 6⅜ | 31.92 | 76500 | 86060 | 95630 |
| 7.069 | 36000 | 40500 | 45000 | 6½ | 33.18 | 78000 | 87750 | 97500 |
| 7.670 | 37500 | 42190 | 46880 | 6⅝ | 34.47 | 79500 | 89440 | 99380 |
| 8.296 | 39000 | 43880 | 48750 | 6¾ | 35.79 | 81000 | 91130 | 101250 |
| 8.946 | 40500 | 45560 | 50630 | 6⅞ | 37.12 | 82500 | 92810 | 103130 |
| 9.621 | 42000 | 47250 | 52500 | 7 | 38.48 | 84000 | 94500 | 105000 |
| 10.32 | 43500 | 48940 | 54380 | 7⅛ | 44.18 | 90000 | 101250 | 112500 |
| 11.05 | 45000 | 50630 | 56250 | 8 | 50.27 | 96000 | 108000 | 120000 |
| 11.79 | 46500 | 52310 | 58130 | 8⅛ | 56.75 | 102000 | 114750 | 127500 |
| 12.57 | 48000 | 54000 | 60000 | 9 | 63.62 | 108000 | 121500 | 135000 |
| 13.36 | 49500 | 55690 | 61880 | 10 | 78.54 | 120000 | 135000 | 150000 |
| 14.19 | 51000 | 57380 | 63750 | 11 | 95.03 | 132000 | 148500 | 165000 |
| 15.03 | 52500 | 59060 | 65630 | 12 | 113.10 | 144000 | 162000 | 180000 |

...—The stress in the end post of a bridge is 250 000 pounds and the ...f the pin is 5⅝″. Required the total thickness of steel pin plates for a ...ue of 15 000 pounds per square inch.

...table the bearing value of a 5⅝″ pin in a 1″ plate for 15 000 pounds ... 84 380 pounds. Therefore the total thickness of metal required is

...7″.

...rest commercial size would therefore be 1½″ on each side, including web ...ssary reinforcing plates.

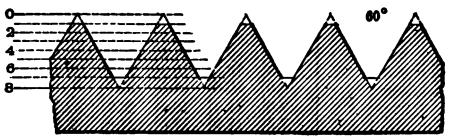
# DIMENSIONS OF BOLTS AND NUTS.

## FRANKLIN INSTITUTE STANDARD.

| Bolts and Threads. | | | | | | Rough Nuts and Heads. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Bolt. | Threads per Inch. | Diameter at Root of Thread. | Width of Flat. | Area of Bolt Body. | Area of Bolt at Root of Thread. | Short Diameter of Square and Hexagon. | Long Diameter of Square. | Long Diameter of Hexagon. | Thickness of Nuts. | Thickness of Heads. |
| Ins. | No. | Ins. | Ins. | Sq. Ins. | Sq. Ins. | Ins. | Ins. | Ins. | Ins. | Ins. |
| ¼ | 20 | .185 | .0062 | .049 | .027 | ½ | .707 | .577 | ¼ | ¼ |
| 5/16 | 18 | .240 | .0070 | .077 | .045 | 9/16 | .840 | .686 | 5/16 | 5/16 |
| 3/8 | 16 | .294 | .0078 | .110 | .068 | 11/16 | .972 | .794 | 3/8 | 3/8 |
| 7/16 | 14 | .344 | .0089 | .150 | .093 | ¾ | 1.105 | .902 | 7/16 | 7/16 |
| ½ | 13 | .400 | .0096 | .196 | .126 | ⅞ | 1.238 | 1.010 | ½ | ½ |
| 9/16 | 12 | .454 | .0104 | .249 | .162 | 15/16 | 1.370 | 1.119 | 9/16 | 9/16 |
| 5/8 | 11 | .507 | .0113 | .307 | .202 | 1 1/16 | 1.503 | 1.227 | 5/8 | 5/8 |
| ¾ | 10 | .620 | .0125 | .442 | .302 | 1 ¼ | 1.768 | 1.443 | ¾ | ¾ |
| ⅞ | 9 | .731 | .0140 | .601 | .420 | 1 7/16 | 2.033 | 1.660 | ⅞ | ⅞ |
| 1 | 8 | .837 | .0156 | .785 | .550 | 1 5/8 | 2.298 | 1.876 | 1 | 1 |
| 1 1/8 | 7 | .940 | .0180 | .994 | .694 | 1 13/16 | 2.563 | 2.093 | 1 1/8 | 1 1/8 |
| 1 ¼ | 7 | 1.065 | .0180 | 1.227 | .893 | 2 | 2.829 | 2.309 | 1 ¼ | 1 ¼ |
| 1 3/8 | 6 | 1.160 | .0210 | 1.485 | 1.057 | 2 3/16 | 3.094 | 2.526 | 1 3/8 | 1 3/8 |
| 1 ½ | 6 | 1.284 | .0210 | 1.767 | 1.295 | 2 3/8 | 3.359 | 2.742 | 1 ½ | 1 ½ |
| 1 5/8 | 5½ | 1.389 | .0227 | 2.074 | 1.515 | 2 9/16 | 3.624 | 2.959 | 1 5/8 | 1 5/8 |
| 1 ¾ | 5 | 1.490 | .0250 | 2.405 | 1.744 | 2 ¾ | 3.889 | 3.175 | 1 ¾ | 1 ¾ |
| 1 7/8 | 5 | 1.615 | .0250 | 2.761 | 2.048 | 2 15/16 | 4.154 | 3.392 | 1 7/8 | 1 7/8 |
| 2 | 4½ | 1.712 | .0280 | 3.142 | 2.302 | 3 1/8 | 4.420 | 3.608 | 2 | 1 15/16 |
| 2 ¼ | 4½ | 1.962 | .0280 | 3.976 | 3.023 | 3 ½ | 4.950 | 4.042 | 2 ¼ | 2 ⅛ |
| 2 ½ | 4 | 2.175 | .0310 | 4.909 | 3.715 | 3 ¾ | 5.480 | 4.475 | 2 ½ | 2 5/16 |
| 2 ¾ | 4 | 2.425 | .0310 | 5.940 | 4.619 | 4 1/16 | 6.011 | 4.908 | 2 ¾ | 2 ½ |
| 3 | 3½ | 2.629 | .0357 | 7.069 | 5.428 | 4 ⅜ | 6.541 | 5.341 | 3 | 2 11/16 |
| 3 ¼ | 3½ | 2.879 | .0357 | 8.296 | 6.510 | 5 | 7.071 | 5.774 | 3 ¼ | 2 ¾ |
| 3 ½ | 3¼ | 3.100 | .0384 | 9.621 | 7.548 | 5 5/16 | 7.602 | 6.207 | 3 ½ | 2 15/16 |
| 3 ¾ | 3 | 3.317 | .0410 | 11.045 | 8.641 | 5 11/16 | 8.132 | 6.640 | 3 ¾ | 3 1/16 |
| 4 | 3 | 3.567 | .0410 | 12.566 | 9.993 | 6 1/16 | 8.662 | 7.073 | 4 | 3 5/16 |
| 4 ¼ | 2¾ | 3.798 | .0435 | 14.186 | 11.329 | 6 ⅜ | 9.193 | 7.506 | 4 ¼ | 3 ½ |
| 4 ½ | 2¾ | 4.028 | .0460 | 15.904 | 12.743 | 6 ¾ | 9.723 | 7.939 | 4 ½ | 3 11/16 |
| 4 ¾ | 2½ | 4.255 | .0480 | 17.721 | 14.220 | 7 1/16 | 10.253 | 8.372 | 4 ¾ | 3 13/16 |
| 5 | 2½ | 4.480 | .0500 | 19.635 | 15.763 | 7 ½ | 10.784 | 8.805 | 5 | 4 1/16 |
| 5 ¼ | 2½ | 4.730 | .0500 | 21.648 | 17.572 | 8 | 11.314 | 9.238 | 5 ¼ | 4 ⅛ |
| 5 ½ | 2½ | 4.953 | .0526 | 23.758 | 19.267 | 8 ⅜ | 11.844 | 9.671 | 5 ½ | 4 5/16 |
| 5 ¾ | 2½ | 5.203 | .0526 | 25.967 | 21.262 | 8 ¾ | 12.375 | 10.104 | 5 ¾ | 4 7/16 |
| 6 | 2¼ | 5.423 | .0555 | 28.274 | 23.098 | 9 1/16 | 12.905 | 10.537 | 6 | 4 ½ |

## RULES FOR PROPORTIONS OF BOLTS AND NUTS.

FRANKLIN INSTITUTE STANDARD.




ıe dimensions of nuts and bolts are determined by the following
, which apply to both square and hexagon.

ıort diameter of rough nut $= 1\frac{1}{2} \times$ diameter of bolt $+ \frac{1}{8}$ in.

ıort diameter of finished nut $= 1\frac{1}{2} \times$ diameter of bolt $+ \frac{1}{16}$ in.

ıickness of rough nut = diameter of bolt.

ıickness of finished nut = diameter of bolt $- \frac{1}{16}$ in.

ıort diameter of rough head $= 1\frac{1}{2} \times$ diameter of bolt $+ \frac{1}{8}$ in.

ıort diameter of finished head $= 1\frac{1}{2} \times$ diameter of bolt $+ \frac{1}{16}$ in.

ıickness of rough head $= \frac{1}{2}$ of short diameter of head.

ıickness of finished head = diameter of bolt $- \frac{1}{16}$ in.

1864, a committee of the Franklin Institute recommended the
e system of screw threads and bolts which was devised by Mr.
iam Sellers, of Philadelphia. This system as far as it relates to
r threads is generally used in the United States, but the propor-
of bolt heads and nuts are not adhered to because the sizes of bar
ired to make the nuts are special and extra work is necessary to
e the bolt heads. Sizes of nuts and bolt heads in accordance with
*Manufacturers' Standard* are given on following pages, Nos. 287,
ınd 289.

# WEIGHTS OF 100 MACHINE BOLTS WITH SQUARE HEADS AND HEXAGON NUTS.

## FRANKLIN INSTITUTE STANDARD SIZES.

Basis — 1 cubic foot Iron = 480 pounds.

| Length under Head to Point. Inches. | Diameter of Bolts in Inches. | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 |
| 1¼ | 4.9 | 8.2 | 12.2 | 17.5 | 24.0 | 31.8 | 41.1 |
| 1⅜ | 5.3 | 8.7 | 13.0 | 18.5 | 25.3 | 33.5 | 43.2 |
| 1¼ | | | | | | | |
| 2 | 5.6 | 9.2 | 13.8 | 19.6 | 26.7 | 35.2 | 45.3 |
| 2¼ | 6.0 | 9.8 | 14.5 | 20.6 | 28.1 | 37.0 | 47.5 |
| 2⅜ | 6.3 | 10.3 | 15.3 | 21.6 | 29.4 | 38.7 | 49.6 |
| 2¼ | 6.6 | 10.8 | 16.1 | 22.7 | 30.8 | 40.4 | 51.7 |
| 3 | 7.0 | 11.4 | 16.8 | 23.7 | 32.1 | 42.1 | 53.9 |
| 3¼ | 7.3 | 11.9 | 17.6 | 24.8 | 33.5 | 43.9 | 56.0 |
| 3⅜ | 7.7 | 12.4 | 18.4 | 25.8 | 34.9 | 45.6 | 58.1 |
| 3¼ | 8.0 | 13.0 | 19.1 | 26.9 | 36.2 | 47.3 | 60.3 |
| 4 | 8.3 | 13.5 | 19.9 | 27.9 | 37.6 | 49.0 | 62.4 |
| 4½ | 9.0 | 14.6 | 21.4 | 30.0 | 40.3 | 52.5 | 66.6 |
| 5 | 9.7 | 15.6 | 23.0 | 32.1 | 43.0 | 55.9 | 70.9 |
| 5½ | 10.4 | 16.7 | 24.5 | 34.2 | 45.8 | 59.4 | 75.2 |
| 6 | 11.1 | 17.8 | 26.0 | 36.2 | 48.5 | 62.8 | 79.4 |
| 6½ | 11.7 | 18.8 | 27.6 | 38.3 | 51.2 | 66.3 | 83.7 |
| 7 | 12.4 | 19.9 | 29.1 | 40.4 | 53.9 | 69.7 | 87.9 |
| 7½ | 13.1 | 21.0 | 30.6 | 42.5 | 56.7 | 73.2 | 92.2 |
| 8 | 13.8 | 22.0 | 32.2 | 44.6 | 59.4 | 76.6 | 96.5 |
| 8½ | 14.5 | 23.1 | 33.7 | 46.7 | 62.1 | 80.1 | 100.7 |
| 9 | 15.1 | 24.2 | 35.3 | 48.8 | 64.8 | 83.5 | 105.0 |
| 9½ | 15.8 | 25.2 | 36.8 | 50.8 | 67.6 | 87.0 | 109.2 |
| 10 | 16.5 | 26.3 | 38.3 | 52.9 | 70.3 | 90.4 | 113.5 |
| 10½ | 17.2 | 27.4 | 39.9 | 55.0 | 73.0 | 93.9 | 117.8 |
| 11 | 17.9 | 28.4 | 41.4 | 57.1 | 75.7 | 97.3 | 122.0 |
| 11½ | 18.5 | 29.5 | 42.9 | 59.2 | 78.5 | 100.8 | 126.3 |
| 12 | . . . | 30.5 | 44.5 | 61.3 | 81.2 | 104.2 | 130.5 |
| 12½ | . . . | 31.6 | 46.0 | 63.3 | 83.9 | 107.7 | 134.8 |
| 13 | . . . | 32.7 | 47.5 | 65.4 | 86.6 | 111.1 | 139.1 |
| 13½ | . . . | 33.7 | 49.1 | 67.5 | 89.4 | 114.6 | 143.3 |
| 14 | . . . | . . . | 50.6 | 69.6 | 92.1 | 118.0 | 147.6 |
| 14½ | . . . | . . . | 52.1 | 71.7 | 94.8 | 121.5 | 151.8 |
| 15 | . . . | . . . | 53.7 | 73.8 | 97.5 | 124.9 | 156.1 |
| 15½ | . . . | . . . | 55.2 | 75.9 | 100.3 | 128.4 | 160.4 |
| 16 | . . . | . . . | . . . | 77.9 | 103.0 | 131.8 | 164.6 |
| 16½ | . . . | . . . | . . . | 80.0 | 105.7 | 135.3 | 168.9 |
| 17 | . . . | . . . | . . . | 82.1 | 108.4 | 138.7 | 173.1 |
| 17½ | . . . | . . . | . . . | 84.2 | 111.2 | 142.2 | 177.4 |
| 18 | . . . | . . . | . . . | . . . | 113.9 | 145.6 | 181.7 |
| 18½ | . . . | . . . | . . . | . . . | 116.6 | 149.1 | 185.9 |
| 19 | . . . | . . . | . . . | . . . | 119.3 | 152.5 | 190.2 |
| 19½ | . . . | . . . | . . . | . . . | 122.1 | 156.0 | 194.4 |
| 20 | . . . | . . . | . . . | . . . | 124.8 | 159.4 | 198.7 |
| One inch in length of 100 Bolts. | 1.36 | 2.13 | 3.07 | 4.18 | 5.45 | 6.90 | 8.52 |
| To obtain Weights with Square Nuts per 100: Add. | .23 | .41 | .66 | .99 | 1.42 | 1.96 | 2.62 |
| Weight of one Hexagon Nut | .0116 | .020 | .031 | .046 | .065 | .088 | .117 |
| Weight of one Hexagon Head. | .0150 | .025 | .039 | .057 | .081 | .109 | .144 |
| Weight of one Square Nut | .0139 | .024 | .038 | .056 | .079 | .108 | .143 |
| *Weight of one* Square Head. | .0173 | .029 | .045 | .068 | .093 | .126 | .167 |

All weights are approximate.

# WEIGHTS OF 100 MACHINE BOLTS WITH SQUARE HEADS AND HEXAGON NUTS.

## FRANKLIN INSTITUTE STANDARD SIZES.

Basis — 1 cubic foot Iron = 480 pounds.

| gth under Head to Point. | Diameter of Bolts in Inches. | | | | | | |
|---|---|---|---|---|---|---|---|
| Inches. | ¾ | ⅞ | 1 | 1⅛ | 1¼ | 1⅜ | 1½ |
| 1½ | 64.5 | 95.2 | 134 | 182 | 240 | 309 | 390 |
| 1¾ | 67.6 | 99.4 | 140 | 189 | 248 | 319 | 402 |
| 2 | 70.6 | 103.5 | 145 | 196 | 257 | 329 | 414 |
| 2¼ | 73.7 | 107.7 | 150 | 203 | 265 | 340 | 426 |
| 2½ | 76.8 | 111.9 | 156 | 210 | 274 | 350 | 439 |
| 2¾ | 79.8 | 116.1 | 161 | 216 | 282 | 360 | 451 |
| 3 | 82.9 | 120.2 | 167 | 223 | 291 | 371 | 463 |
| 3¼ | 86.0 | 124.4 | 172 | 230 | 300 | 381 | 475 |
| 3½ | 89.1 | 128.6 | 178 | 237 | 308 | 391 | 488 |
| 3¾ | 92.1 | 132.8 | 183 | 244 | 317 | 402 | 500 |
| 4 | 95.2 | 136.9 | 189 | 251 | 325 | 412 | 512 |
| 4½ | 101.3 | 145.3 | 199 | 265 | 342 | 432 | 537 |
| 5 | 107.4 | 153.6 | 210 | 279 | 359 | 453 | 561 |
| 5½ | 113.6 | 162.0 | 221 | 292 | 376 | 474 | 586 |
| 6 | 119.7 | 170.3 | 232 | 306 | 393 | 494 | 610 |
| 6½ | 125.9 | 178.7 | 243 | 320 | 410 | 515 | 635 |
| 7 | 132.0 | 187.0 | 254 | 334 | 427 | 536 | 659 |
| 7½ | 138.1 | 195.4 | 265 | 348 | 444 | 556 | 684 |
| 8 | 144.3 | 203.7 | 276 | 361 | 461 | 577 | 709 |
| 8½ | 150.4 | 212.1 | 287 | 375 | 478 | 597 | 733 |
| 9 | 156.5 | 220.4 | 298 | 389 | 495 | 618 | 758 |
| 9½ | 162.7 | 228.8 | 308 | 402 | 513 | 639 | 782 |
| 10 | 168.8 | 237.1 | 319 | 417 | 530 | 659 | 807 |
| 10½ | 174.9 | 245.5 | 330 | 430 | 547 | 680 | 831 |
| 11 | 181.1 | 253.8 | 341 | 444 | 564 | 701 | 856 |
| 11½ | 187.2 | 262.2 | 352 | 458 | 581 | 721 | 880 |
| 12 | 193.3 | 270.5 | 363 | 472 | 598 | 742 | 905 |
| 12½ | 199.5 | 278.9 | 374 | 486 | 615 | 762 | 929 |
| 13 | 205.6 | 287.2 | 385 | 499 | 632 | 783 | 954 |
| 13½ | 211.7 | 295.6 | 396 | 513 | 649 | 804 | 978 |
| 14 | 217.9 | 303.9 | 407 | 527 | 666 | 824 | 1003 |
| 14½ | 224.0 | 312.3 | 417 | 541 | 683 | 845 | 1027 |
| 15 | 230.1 | 320.6 | 428 | 555 | 700 | 866 | 1052 |
| 15½ | 236.3 | 329.0 | 439 | 568 | 717 | 886 | 1077 |
| 16 | 242.4 | 337.3 | 450 | 582 | 734 | 907 | 1101 |
| 16½ | 248.5 | 345.7 | 461 | 596 | 751 | 927 | 1126 |
| 17 | 254.7 | 354.0 | 472 | 610 | 768 | 948 | 1150 |
| 17½ | 260.8 | 362.4 | 483 | 624 | 785 | 969 | 1175 |
| 18 | 266.9 | 370.7 | 494 | 637 | 802 | 989 | 1199 |
| 18½ | 273.1 | 379.1 | 505 | 651 | 819 | 1010 | 1224 |
| 19 | 279.2 | 387.4 | 516 | 665 | 836 | 1031 | 1248 |
| 19½ | 285.3 | 395.8 | 526 | 679 | 853 | 1051 | 1273 |
| 20 | 291.5 | 404.1 | 537 | 693 | 870 | 1072 | 1297 |
| nch in length of 100 Bolts. | 12.27 | 16.70 | 21.82 | 27.61 | 34.09 | 41.25 | 49.09 |
| obtain Weights with } are Nuts per 100: Add . } | 4.35 | 6.72 | 9.81 | 13.73 | 18.57 | 24.42 | 31.42 |
| ht of one Hexagon Nut . | .190 | .289 | .417 | .579 | .777 | 1.016 | 1.299 |
| ht of one Hexagon Head. | .235 | .357 | .516 | .616 | .962 | 1.259 | 1.611 |
| ht of one Square Nut . . | .234 | .356 | .515 | .716 | .963 | 1.260 | 1.614 |
| ht of one Square Head . . | .271 | .412 | .596 | .827 | 1.111 | 1.455 | 1.866 |

*All* weights are approximate.

# WEIGHTS OF 100 MACHINE BOLTS WITH SQUARE HEADS AND NUTS.

## WROUGHT IRON.

### MANUFACTURERS' STANDARD SIZES.

Basis — Hoopes & Townsend's List.

| Length under Head to Point. Inches. | Diameter of Bolt in Inches. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 3/4 |
| 1½ | 3.9 | 6.2 | 9.7 | 14.7 | 20.4 | 26.0 | 37.0 | 58.0 |
| 2 | 4.6 | 7.2 | 11.3 | 16.5 | 22.4 | 29.0 | 39.9 | 63.2 |
| 2½ | 5.4 | 8.2 | 12.9 | 18.5 | 25.0 | 32.2 | 44.1 | 69.0 |
| 3 | 6.2 | 9.3 | 14.5 | 20.5 | 27.8 | 35.4 | 48.3 | 75.2 |
| 3½ | 6.9 | 10.4 | 16.1 | 22.6 | 30.6 | 38.7 | 52.5 | 81.4 |
| 4 | 7.6 | 11.5 | 17.7 | 24.7 | 33.4 | 42.0 | 56.7 | 87.6 |
| 4½ | 8.3 | 12.6 | 19.2 | 26.8 | 36.2 | 45.3 | 60.9 | 93.8 |
| 5 | 9.0 | 13.7 | 20.7 | 28.9 | 39.0 | 48.6 | 65.1 | 100.0 |
| 5½ | 9.7 | 14.8 | 22.2 | 31.0 | 41.8 | 51.9 | 69.2 | 106.1 |
| 6 | 10.4 | 15.9 | 23.7 | 33.1 | 44.6 | 55.2 | 73.4 | 112.2 |
| 6½ | 11.1 | 17.0 | 25.2 | 35.2 | 47.4 | 58.5 | 77.6 | 118.3 |
| 7 | 11.8 | 18.1 | 26.7 | 37.3 | 50.2 | 61.8 | 81.8 | 124.4 |
| 7½ | 12.5 | 19.2 | 28.2 | 39.4 | 53.1 | 65.1 | 86.0 | 130.5 |
| 8 | 13.2 | 20.3 | 29.7 | 41.5 | 56.0 | 68.5 | 90.0 | 136.6 |
| 9 | 14.6 | 22.5 | 33.1 | 45.7 | 61.5 | 75.2 | 98.0 | 148.8 |
| 10 | . . . | . . . | 36.5 | 49.9 | 67.0 | 81.9 | 106.3 | 161.0 |
| 11 | . . . | . . . | 40.0 | 54.1 | 72.5 | 88.7 | 114.6 | 173.2 |
| 12 | . . . | . . . | 43.5 | 58.3 | 78.0 | 95.5 | 122.9 | 184.4 |
| 13 | . . . | . . . | 47.0 | 61.5 | 83.5 | 102.3 | 131.2 | 196.6 |
| 14 | . . . | . . . | . . . | . . . | 89.0 | 109.1 | 139.5 | 208.8 |
| 15 | . . . | . . . | . . . | . . . | 94.5 | 116.0 | 148.0 | 221.0 |
| 16 | . . . | . . . | . . . | . . . | 100.0 | 123.0 | 156.5 | 233.2 |
| 17 | . . . | . . . | . . . | . . . | 105.5 | 130.0 | 165.0 | 245.4 |
| 18 | . . . | . . . | . . . | . . . | 111.0 | 137.0 | 173.5 | 257.6 |
| 19 | . . . | . . . | . . . | . . . | 116.5 | 144.0 | 182.0 | 269.8 |
| 20 | . . . | . . . | . . . | . . . | 122.0 | 151.0 | 190.5 | 282.0 |
| 21 | . . . | . . . | . . . | . . . | 127.5 | 158.0 | 198.0 | 294.0 |
| 22 | . . . | . . . | . . . | . . . | . . . | . . . | 206.0 | 306.0 |
| 23 | . . . | . . . | . . . | . . . | . . . | . . . | 215.0 | 318.0 |
| 24 | . . . | . . . | . . . | . . . | . . . | . . . | 224.0 | 330.0 |
| 25 | . . . | . . . | . . . | . . . | . . . | . . . | 233.0 | 342.0 |

# WEIGHTS OF 100 MACHINE BOLTS WITH SQUARE HEADS AND NUTS.

## WROUGHT IRON.

### MANUFACTURERS' STANDARD SIZES.

Basis — Hoopes & Townsend's List.

| Length under Head to Point. Inches. | Diameter of Bolt in Inches. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | $\frac{7}{8}$ | 1 | $1\frac{1}{8}$ | $1\frac{1}{4}$ | $1\frac{3}{8}$ | $1\frac{1}{2}$ | $1\frac{3}{4}$ | 2 |
| | . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . |
| 2 | 98 | 145 | . . . | . . . | . . . | . . . | . . . | . . . |
| $2\frac{1}{2}$ | 106 | 153 | . . . | . . . | . . . | . . . | . . . | . . . |
| 3 | 114 | 163 | 240 | 309 | 350 | 480 | . . . | . . . |
| $3\frac{1}{2}$ | 122 | 174 | 253 | 325 | 370 | 500 | . . . | . . . |
| 4 | 130 | 185 | 267 | 342 | 390 | 520 | 800 | . . . |
| $4\frac{1}{2}$ | 138 | 196 | 281 | 359 | 410 | 545 | 833 | . . . |
| 5 | 147 | 207 | 295 | 376 | 430 | 570 | 866 | 1370 |
| $5\frac{1}{2}$ | 155 | 218 | 309 | 394 | 450 | 595 | 900 | 1414 |
| 6 | 163 | 229 | 323 | 412 | 470 | 620 | 934 | 1458 |
| $6\frac{1}{2}$ | 172 | 240 | 337 | 430 | 490 | 645 | 968 | 1502 |
| 7 | 180 | 251 | 351 | 448 | 510 | 670 | 1002 | 1546 |
| $7\frac{1}{2}$ | 187 | 262 | 365 | 466 | 530 | 695 | 1036 | 1590 |
| 8 | 195 | 273 | 379 | 484 | 550 | 725 | 1070 | 1634 |
| 9 | 212 | 295 | 407 | 518 | 590 | 775 | 1138 | 1722 |
| 10 | 229 | 317 | 435 | 552 | 630 | 825 | 1206 | 1810 |
| 11 | 246 | 339 | 463 | 586 | 670 | 875 | 1274 | 1898 |
| 12 | 263 | 361 | 491 | 620 | 710 | 925 | 1342 | 1986 |
| 13 | 280 | 383 | 519 | 655 | 751 | 975 | 1410 | 2074 |
| 14 | 297 | 405 | 547 | 690 | 793 | 1025 | 1478 | 2162 |
| 15 | 314 | 427 | 575 | 725 | 835 | 1075 | 1548 | 2250 |
| 16 | 331 | 449 | 603 | 760 | 877 | 1125 | 1616 | 2338 |
| 17 | 348 | 471 | 631 | 795 | 919 | 1175 | 1684 | 2426 |
| 18 | 365 | 493 | 659 | 830 | 961 | 1225 | 1752 | 2514 |
| 19 | 382 | 515 | 687 | 865 | 1003 | 1275 | 1820 | 2602 |
| 20 | 399 | 537 | 715 | 900 | 1045 | 1325 | 1888 | 2690 |
| 21 | 416 | 559 | 743 | 935 | 1087 | 1375 | 1956 | 2778 |
| 22 | 437 | 581 | 771 | 970 | 1129 | 1425 | 2024 | 2866 |
| 23 | 454 | 603 | 799 | 1005 | 1171 | 1475 | 2092 | 2954 |
| 24 | 470 | 625 | 827 | 1040 | 1213 | 1525 | 2160 | 3042 |
| 25 | 487 | 647 | 855 | 1075 | 1255 | 1575 | 2228 | 3130 |

Bolts from $1\frac{1}{8}$ inches to 2 inches, inclusive, are fitted with nuts made to U. S. standard.

# WEIGHTS OF ROUND HEADED RIVETS A ROUND-HEADED BOLTS WITHOUT NUTS.

## WROUGHT IRON.

Basis — 1 cubic foot Iron = 480 pounds.

| Length under Head to Point. Inches. | Diameter of Rivet in Inch | | | | | |
|---|---|---|---|---|---|---|
| | ⅜ | ½ | ⅝ | ¾ | ⅞ | 1 |
| 1 | 4.7 | 9.3 | 16.0 | 25.2 | 37.2 | 52.6 |
| 1¼ | 5.5 | 10.7 | 18.1 | 28.3 | 41.3 | 58.0 |
| 1½ | 6.2 | 12.1 | 20.2 | 31.3 | 45.5 | 63.5 |
| 1¾ | 7.0 | 13.4 | 22.4 | 34.4 | 49.7 | 68.9 |
| 2 | 7.8 | 14.8 | 24.5 | 37.5 | 53.9 | 74.4 |
| 2¼ | 8.5 | 16.2 | 26.6 | 40.5 | 58.0 | 79.8 |
| 2½ | 9.3 | 17.5 | 28.8 | 43.6 | 62.2 | 85.3 |
| 2¾ | 10.1 | 18.9 | 30.9 | 46.7 | 66.4 | 90.7 |
| 3 | 10.8 | 20.3 | 33.0 | 49.8 | 70.6 | 96.2 |
| 3¼ | 11.6 | 21.6 | 35.1 | 52.8 | 74.7 | 101.6 |
| 3½ | 12.4 | 23.0 | 37.3 | 55.9 | 78.9 | 107.1 |
| 3¾ | 13.1 | 24.3 | 39.4 | 59.0 | 83.1 | 112.6 |
| 4 | 13.9 | 25.7 | 41.5 | 62.0 | 87.3 | 118.0 |
| 4¼ | 14.7 | 27.1 | 43.7 | 65.1 | 91.4 | 123.5 |
| 4½ | 15.4 | 28.4 | 45.8 | 68.2 | 95.6 | 128.9 |
| 4¾ | 16.2 | 29.8 | 47.9 | 71.2 | 99.8 | 134.4 |
| 5 | 17.0 | 31.2 | 50.1 | 74.3 | 104.0 | 139.8 |
| 5¼ | 17.7 | 32.5 | 52.2 | 77.4 | 108.2 | 145.3 |
| 5½ | 18.5 | 33.9 | 54.3 | 80.4 | 112.3 | 150.7 |
| 5¾ | 19.3 | 35.3 | 56.4 | 83.5 | 116.5 | 156.2 |
| 6 | 20.0 | 36.6 | 58.6 | 86.6 | 120.7 | 161.6 |
| 6¼ | 20.8 | 38.0 | 60.7 | 89.6 | 124.8 | 167.1 |
| 6½ | 21.6 | 39.3 | 62.8 | 92.7 | 129.0 | 172.5 |
| 6¾ | 22.3 | 40.7 | 65.0 | 95.8 | 133.2 | 178.0 |
| 7 | 23.1 | 42.1 | 67.1 | 98.8 | 137.4 | 183.5 |
| 7¼ | 23.9 | 43.4 | 69.2 | 101.9 | 141.6 | 188.9 |
| 7½ | 24.6 | 44.8 | 71.4 | 105.0 | 145.7 | 194.4 |
| 7¾ | 25.4 | 46.2 | 73.5 | 108.0 | 149.9 | 199.8 |
| 8 | 26.2 | 47.5 | 75.6 | 111.1 | 154.1 | 205.3 |
| 8½ | 27.7 | 50.2 | 79.9 | 117.2 | 162.4 | 216.2 |
| 9 | 29.2 | 53.0 | 84.1 | 123.4 | 170.8 | 227.1 |
| 9½ | 30.8 | 55.7 | 88.4 | 129.5 | 179.1 | 238.0 |
| 10 | 32.3 | 58.4 | 92.7 | 135.6 | 187.5 | 248.8 |
| 10½ | 33.8 | 61.2 | 96.9 | 141.8 | 195.8 | 259.8 |
| 11 | 35.4 | 63.9 | 101.2 | 147.9 | 204.2 | 270.7 |
| 11½ | 36.9 | 66.6 | 105.4 | 154.1 | 212.5 | 281.6 |
| 12 | 38.4 | 69.3 | 109.7 | 160.2 | 220.9 | 292.5 |
| inch in length of 100 Rivets | 3.07 | 5.45 | 8.52 | 12.27 | 16.70 | 21.82 |
| *ght of* 100 Rivet Heads . . | 1.78 | 4.82 | 9.95 | 16.12 | 24.29 | 34.77 |

# WEIGHTS AND DIMENSIONS OF BOLT HEADS.

## MANUFACTURERS' STANDARD SIZES.

BASIS—HOOPES & TOWNSEND'S LIST.

| Diameter of Bolt. | Square. | | | | Hexagon. | | | |
|---|---|---|---|---|---|---|---|---|
| | Short Diameter. | Long Diameter. | Thickness. | Weight per 100. | Short Diameter. | Long Diameter. | Thickness. | Weight per 100. |
| Inches. | Inches. | Inches. | Inches. | Pounds. | Inches. | Inches. | Inches. | Pounds. |
| 1/4 | 7/16 | .619 | 3/16 | 1.0 | 7/16 | .505 | 3/16 | .9 |
| 5/16 | 1/2 | .707 | 1/4 | 1.7 | 1/2 | .578 | 1/4 | 1.5 |
| 3/8 | 19/32 | .840 | 9/32 | 2.8 | 19/32 | .686 | 9/32 | 2.4 |
| 7/16 | 11/16 | .972 | 3/8 | 4.9 | 11/16 | .794 | 3/8 | 4.3 |
| 1/2 | 3/4 | 1.061 | 7/16 | 6.8 | 3/4 | .866 | 7/16 | 5.9 |
| 9/16 | 27/32 | 1.193 | 1/2 | 9.9 | 27/32 | .974 | 1/2 | 8.6 |
| 5/8 | 15/16 | 1.326 | 17/32 | 13.0 | 15/16 | 1.083 | 17/32 | 11.2 |
| 3/4 | 1 1/8 | 1.591 | 5/8 | 22.0 | 1 1/8 | 1.299 | 5/8 | 19.0 |
| 7/8 | 1 5/16 | 1.856 | 3/4 | 34.8 | 1 5/16 | 1.516 | 3/4 | 33.1 |
| 1 | 1 1/2 | 2.122 | 7/8 | 54.7 | 1 1/2 | 1.733 | 7/8 | 47.4 |
| 1 1/8 | 1 5/8 | 2.298 | 1 | 73.3 | 1 5/8 | 1.877 | 1 | 63.5 |
| 1 1/4 | 1 3/4 | 2.475 | 1 1/8 | 95.7 | 1 3/4 | 2.021 | 1 1/8 | 82.9 |
| 1 3/8 | 2 1/8 | 3.006 | 1 1/4 | 156.8 | 2 | 2.309 | 1 3/8 | 132.3 |
| 1 1/2 | 2 3/8 | 3.359 | 1 3/8 | 215.4 | 2 3/8 | 2.743 | 1 1/2 | 203.5 |
| 1 5/8 | 2 1/2 | 3.536 | 1 1/2 | 260.3 | 2 1/2 | 2.888 | 1 5/8 | 244.4 |
| 1 3/4 | 2 3/4 | 3.889 | 1 5/8 | 341.3 | 2 3/4 | 3.176 | 1 3/4 | 318.4 |
| 1 7/8 | 3 | 4.243 | 1 3/4 | 437.4 | 3 | 3.464 | 1 7/8 | 408.2 |
| 2 | 3 1/8 | 4.420 | 1 7/8 | 508.5 | 3 1/8 | 3.610 | 2 | 469.9 |

# WEIGHTS AND DIMENSIONS OF HEXAGO NUTS.

## MANUFACTURERS' STANDARD SIZES.

BASIS—HOOPES & TOWNSEND'S LIST.

| Diameter of Bolt. | Short Diameter. | Long Diameter. | Thickness. | Diameter of Rough Hole. | Plain. | | Cupped | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Weight per 100. | Number in 100. | Weight per 100. | Nu in |
| Inches. | Inches. | Inches. | Inches. | Inches. | Pounds. | Pounds. | Pounds. | Pou |
| $\frac{1}{4}$ | $\frac{1}{2}$ | .578 | $\frac{1}{4}$ | $\frac{7}{32}$ | 1.3 | 7800 | 1.2 | 8 |
| $\frac{5}{16}$ | $\frac{5}{8}$ | .722 | $\frac{5}{16}$ | $\frac{9}{32}$ | 2.3 | 4440 | 2.1 | 4 |
| $\frac{3}{8}$ | $\frac{3}{4}$ | .866 | $\frac{3}{8}$ | $\frac{11}{32}$ | 4.3 | 2330 | 4.0 | 2 |
| $\frac{7}{16}$ | $\frac{7}{8}$ | 1.011 | $\frac{7}{16}$ | $\frac{13}{32}$ | 7.0 | 1430 | 6.3 | 1 |
| $\frac{1}{2}$ | $\frac{7}{8}$ | 1.011 | $\frac{1}{2}$ | $\frac{7}{16}$ | 7.5 | 1330 | 6.9 | 1 |
| $\frac{1}{2}$ | 1 | 1.155 | $\frac{1}{2}$ | $\frac{7}{16}$ | 9.9 | 1010 | 9.2 | 1 |
| $\frac{1}{2}$ | 1 | 1.155 | $\frac{9}{16}$ | $\frac{7}{16}$ | 10.8 | 930 | 10.2 | |
| $\frac{9}{16}$ | $1\frac{1}{8}$ | 1.299 | $\frac{9}{16}$ | $\frac{1}{2}$ | 13.7 | 730 | 12.5 | |
| $\frac{5}{8}$ | $1\frac{1}{8}$ | 1.299 | $\frac{5}{8}$ | $\frac{9}{16}$ | 15.9 | 630 | 15.2 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.299 | $\frac{5}{8}$ | $\frac{9}{16}$ | 17.9 | 560 | 17.0 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.444 | $\frac{5}{8}$ | $\frac{9}{16}$ | 19.5 | 514 | 18.5 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.444 | $\frac{5}{8}$ | $\frac{9}{16}$ | 23.0 | 435 | 21.7 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.444 | $\frac{5}{8}$ | $\frac{9}{16}$ | 22.2 | 450 | 20.6 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.588 | $\frac{5}{8}$ | $\frac{9}{16}$ | 26.6 | 376 | 25.4 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.588 | $\frac{5}{8}$ | $\frac{9}{16}$ | 30.3 | 330 | 28.8 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.733 | $\frac{5}{8}$ | $\frac{9}{16}$ | 34.5 | 290 | 32.3 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.733 | $\frac{5}{8}$ | $\frac{9}{16}$ | 40.0 | 250 | 37.6 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.733 | $\frac{5}{8}$ | $\frac{9}{16}$ | 37.7 | 265 | 35.3 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.733 | 1 | $\frac{9}{16}$ | 45.9 | 218 | 43.5 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.877 | $\frac{7}{8}$ | $\frac{9}{16}$ | 45.3 | 221 | 42.6 | |
| $\frac{5}{8}$ | $1\frac{1}{4}$ | 1.877 | 1 | $\frac{9}{16}$ | 50.8 | 197 | 47.6 | |
| 1 | $1\frac{3}{4}$ | 2.021 | 1 | $\frac{11}{16}$ | 57.5 | 174 | 53.8 | |
| 1 | $1\frac{3}{4}$ | 2.021 | $1\frac{1}{8}$ | $\frac{11}{16}$ | 63.7 | 157 | 59.5 | |
| $1\frac{1}{8}$ | 2 | 2.309 | $1\frac{1}{4}$ | $\frac{15}{16}$ | 100.0 | 100 | 90.9 | |
| $1\frac{1}{4}$ | $2\frac{1}{4}$ | 2.599 | $1\frac{3}{8}$ | $1\frac{1}{16}$ | 138.9 | 72 | 126.6 | |
| $1\frac{3}{8}$ | $2\frac{1}{4}$ | 2.888 | $1\frac{1}{2}$ | $1\frac{3}{16}$ | 185.2 | 54 | 169.5 | |
| $1\frac{1}{2}$ | $2\frac{3}{4}$ | 3.176 | $1\frac{5}{8}$ | $1\frac{5}{16}$ | 243.9 | 41 | 222.2 | |
| $1\frac{5}{8}$ | 3 | 3.464 | $1\frac{3}{4}$ | $1\frac{7}{16}$ | 333.3 | 30 | 303.0 | |
| $1\frac{3}{4}$ | $3\frac{1}{4}$ | 3.754 | $1\frac{7}{8}$ | $1\frac{9}{16}$ | 408.2 | $24\frac{1}{2}$ | 370.4 | |
| $1\frac{7}{8}$ | $3\frac{1}{4}$ | 4.043 | 2 | $1\frac{11}{16}$ | 493.8 | $20\frac{1}{4}$ | 459.8 | |
| 2 | $3\frac{1}{2}$ | 4.043 | 2 | $1\frac{13}{16}$ | 487.8 | $20\frac{1}{2}$ | 454.5 | |
| 2 | $3\frac{1}{2}$ | 4.043 | $2\frac{1}{8}$ | $1\frac{13}{16}$ | 512.8 | $19\frac{1}{2}$ | 487.8 | |

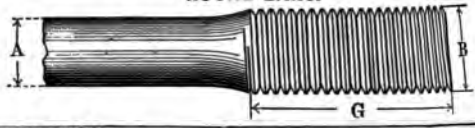
# WEIGHTS AND DIMENSIONS OF SQUARE NUTS.

## MANUFACTURERS' STANDARD SIZES.

BASIS—HOOPES & TOWNSEND'S LIST.

| Diameter of Bolt. | Short Diameter. | Long Diameter. | Thickness. | Diameter of Rough Hole. | Plain. | | Cupped. | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Weight per 100. | Number in 100 | Weight per 100. | Number in 100 |
| Inches. | Inches. | Inches. | Inches. | Inches | Pounds. | Pounds. | Pounds. | Pounds. |
| 1/4 | 1/2 | .707 | 1/4 | 7/32 | 1.5 | 6750 | 1.4 | 7200 |
| 5/16 | 5/8 | .884 | 5/16 | 9/32 | 2.8 | 3540 | 2.5 | 4000 |
| 3/8 | 3/4 | 1.061 | 3/8 | 11/32 | 4.8 | 2100 | 4.2 | 2380 |
| 7/16 | 7/8 | 1.237 | 7/16 | 13/32 | 7.5 | 1330 | 6.8 | 1460 |
| 1/2 | 7/8 | 1.237 | 1/2 | 7/16 | 8.9 | 1120 | 8.1 | 1230 |
| 1/2 | 1 | 1.414 | 1/2 | 7/16 | 11.9 | 840 | 10.8 | 930 |
| 9/16 | 1 1/8 | 1.591 | 9/16 | 1/2 | 15.4 | 650 | 14.3 | 700 |
| 5/8 | 1 1/8 | 1.591 | 5/8 | 9/16 | 17.3 | 575 | 16.1 | 620 |
| 5/8 | 1 1/4 | 1.768 | 5/8 | 9/16 | 23.0 | 435 | 21.1 | 475 |
| 3/4 | 1 1/4 | 1.768 | 3/4 | 21/32 | 27.8 | 360 | 25.0 | 400 |
| 3/4 | 1 3/8 | 1.945 | 3/4 | 21/32 | 31.7 | 315 | 29.0 | 345 |
| 3/4 | 1 1/2 | 2.122 | 3/4 | 21/32 | 41.0 | 244 | 37.0 | 270 |
| 7/8 | 1 1/2 | 2.122 | 7/8 | 25/32 | 46.5 | 215 | 41.7 | 240 |
| 7/8 | 1 5/8 | 2.298 | 7/8 | 25/32 | 55.6 | 180 | 48.8 | 205 |
| 7/8 | 1 3/4 | 2.475 | 7/8 | 25/32 | 61.3 | 163 | 54.6 | 183 |
| 1 | 1 3/4 | 2.475 | 1 | 7/8 | 70.9 | 141 | 64.1 | 156 |
| 1 | 2 | 2.828 | 1 | 7/8 | 95.2 | 105 | 87.0 | 115 |
| 1 1/8 | 2 | 2.828 | 1 1/8 | 1 5/16 | 102.0 | 98 | 94.3 | 106 |
| 1 1/8 | 2 1/4 | 3.182 | 1 1/8 | 1 5/16 | 135.1 | 74 | 123.5 | 81 |
| 1 1/4 | 2 1/4 | 3.182 | 1 1/4 | 1 1/16 | 156.3 | 64 | 142.9 | 70 |
| 1 1/4 | 2 1/2 | 3.536 | 1 1/4 | 1 1/16 | 192.3 | 52 | 175.4 | 57 |
| 1 3/8 | 2 3/4 | 3.889 | 1 3/8 | 1 3/16 | 250.0 | 40 | 227.3 | 44 |
| 1 1/2 | 3 | 4.243 | 1 1/2 | 1 5/16 | 317.5 | 31 1/2 | 285.7 | 35 |
| 1 5/8 | 3 1/4 | 4.597 | 1 5/8 | 1 7/16 | 454.5 | 22 | 400.0 | 25 |
| 1 3/4 | 3 1/2 | 4.950 | 1 3/4 | 1 9/16 | 555.6 | 18 | 500.0 | 20 |
| 1 7/8 | 3 3/4 | 5.303 | 1 7/8 | 1 11/16 | 666.7 | 15 | 625.0 | 16 |
| 2 | 4 | 5.657 | 2 | 1 13/16 | 816.3 | 12 1/4 | 784.3 | 12 3/4 |

# UPSET SCREW ENDS.
## ROUND BARS.

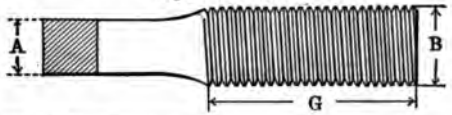



| Dimensions of Upset End. | | | | Dimensions and Proportions of Body of B | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Screw. | Length of Upset. | Area at Root of Thread. | Number of Threads per Inch. | Diameter of Bar. | Area at Body of Bar. | Weight per Foot of Bar. | Add for Upset. | Excess of Area at Root of Thread over that of Body of Bar. | Diameter of Bar. | Area of Body of Bar. | Weight per Foot of Bar. | Add for Upset. |
| B | G | | | A | | | | | A | | | |
| In. | In. | Sq. In. | | In. | Sq. In. | Pounds. | In. | Per Ct. | In. | Sq. In. | Pounds. | I |
| 7/8 | 4 1/4 | .302 | 10 | 1/2 | .196 | .668 | 6 1/2 | 54 | 9/16 | .249 | .845 | 4 |
| 7/8 | 4 1/2 | .420 | 9 | 5/8 | .307 | 1.043 | 5 1/2 | 37 | | | | |
| 1 | 4 1/2 | .550 | 8 | 11/16 | .371 | 1.262 | 6 1/4 | 48 | 3/4 | .442 | 1.502 | 4 |
| 1 1/8 | 4 1/2 | .694 | 7 | 11/16 | .519 | 1.763 | 5 1/2 | 34 | | | | |
| 1 1/8 | 4 1/2 | .893 | 7 | 13/16 | .601 | 2.044 | 6 1/4 | 49 | 15/16 | .690 | 2.347 | 4 |
| 1 1/4 | 5 | 1.057 | 6 | 1 | .785 | 2.67 | 4 1/2 | 35 | 1 1/16 | .887 | 3.01 | 4 |
| 1 1/4 | 5 | 1.295 | 6 | 1 1/16 | .994 | 3.38 | 4 1/2 | 30 | 1 3/16 | 1.108 | 3.77 | 3 |
| 1 3/8 | 5 1/4 | 1.515 | 5 1/2 | 1 1/4 | 1.227 | 4.17 | 4 1/2 | 23 | | | | |
| 1 3/8 | 5 1/4 | 1.744 | 5 | 1 5/16 | 1.353 | 4.60 | 5 | 29 | 1 3/8 | 1.485 | 5.05 | 4 |
| 1 3/8 | 5 1/2 | 2.048 | 5 | 1 7/16 | 1.623 | 5.52 | 4 3/4 | 26 | | | | |
| 2 | 5 1/2 | 2.302 | 4 1/2 | 1 1/2 | 1.767 | 6.01 | 5 1/4 | 30 | 1 9/16 | 1.918 | 6.52 | 4 |
| 2 1/8 | 5 1/2 | 2.650 | 4 1/2 | 1 5/8 | 2.074 | 7.05 | 5 | 28 | 1 11/16 | 2.237 | 7.60 | 4 |
| 2 1/8 | 5 1/2 | 3.023 | 4 1/2 | 1 3/4 | 2.405 | 8.18 | 4 3/4 | 26 | 1 13/16 | 2.580 | 8.77 | 4 |
| 2 1/8 | 6 | 3.419 | 4 1/2 | 1 7/8 | 2.761 | 9.39 | 4 1/2 | 24 | | | | |
| 2 1/8 | 6 | 3.715 | 4 | 1 15/16 | 2.948 | 10.02 | 5 | 26 | 2 | 3.142 | 10.68 | 3 |
| 2 1/4 | 6 1/4 | 4.155 | 4 | 2 1/16 | 3.341 | 11.36 | 4 3/4 | 24 | 2 1/8 | 3.547 | 12.06 | 4 |
| 2 1/4 | 6 1/4 | 4.619 | 4 | 2 1/16 | 3.758 | 12.78 | 4 1/2 | 23 | | | | |
| 2 1/4 | 6 1/2 | 5.108 | 4 | 2 1/4 | 3.976 | 13.52 | 5 1/4 | 28 | 2 5/16 | 4.200 | 14.28 | |
| 3 | 6 1/2 | 5.428 | 3 1/2 | 2 5/16 | 4.430 | 15.07 | 4 1/2 | 23 | | | | |
| 3 1/8 | 6 3/4 | 5.957 | 3 1/2 | 2 7/16 | 4.666 | 15.86 | 5 1/2 | 28 | 2 1/4 | 4.909 | 16.69 | |
| 3 1/4 | 6 3/4 | 6.510 | 3 1/2 | 2 9/16 | 5.157 | 17.53 | 5 1/4 | 26 | 2 3/8 | 5.412 | 18.40 | |
| 3 1/4 | 7 | 7.087 | 3 1/2 | 2 11/16 | 5.673 | 19.29 | 5 | 25 | 2 3/4 | 5.940 | 20.20 | |
| 3 1/4 | 7 | 7.548 | 3 1/4 | 2 11/16 | 6.213 | 21.12 | 4 3/4 | 22 | | | | |
| 3 1/4 | 7 1/4 | 8.171 | 3 1/4 | 2 7/8 | 6.492 | 22.07 | 5 1/4 | 26 | 2 15/16 | 6.777 | 23.04 | |
| 3 3/8 | 7 1/4 | 8.641 | 3 | 3 | 7.069 | 24.03 | 6 1/4 | 22 | | | | |
| 3 3/8 | 7 1/2 | 9.305 | 3 | 3 1/8 | 7.670 | 26.08 | 5 1/4 | 21 | | | | |
| 4 | 7 1/2 | 9.993 | 3 | 3 1/4 | 8.296 | 28.20 | 4 3/4 | 20 | | | | |

Upset Ends of sizes given in first column are used with one or two sizes shown in the two columns headed "Diameter of Bar. A."

Lengths of Upset Ends above are best adapted for use with Turnbuckle ard length, six inches between heads, as shown on page **294.** Length Ends for use with ordinary Right and Left Nuts, shown on page **295,** n inch shorter than above. Upset Ends 3 1/16", 3 3/16", 3 5/16" and 3 7/16" diamet *sizes for which* Right and Left Nuts and Turnbuckles are not regularly m

# UPSET SCREW ENDS.
## SQUARE BARS.

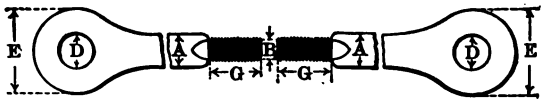



| Dimensions of Upset End. | | | Dimensions and Proportions of Body of Bar. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Length or Upset. G | Area at Root of Thread. | Number of Threads per Inch. | Side of Square Bar. A | Area of Body of Bar. | Weight per Foot of Bar. | Add for Upset. | Excess of Area at Root of Thread over that of Body of Bar. | Side of Square Bar. A | Area of Body of Bar. | Weight per Foot of Bar. | Add for Upset. | Excess of Area at Root of Thread over that of Body of Bar. |
| In. | Sq. In. | | In. | Sq. In. | Pounds. | In. | Per Ct. | In. | Sq. In. | Pounds. | In. | Per Ct. |
| 4¼ | .302 | 10 | ½ | .250 | .850 | 4 | 21 | | | | | |
| 4½ | .420 | 9 | 9/16 | .316 | 1.076 | 5 | 33 | | | | | |
| 4¾ | .550 | 8 | 7/16 | .391 | 1.328 | 5¾ | 41 | 11/16 | .473 | 1.607 | 3¾ | 17 |
| 4¾ | .694 | 7 | 9/16 | .563 | 1.913 | 4¼ | 23 | | | | | |
| 4¾ | .893 | 7 | 5/8 | .660 | 2.245 | 5 | 35 | | | | | |
| 5 | 1.057 | 6 | 11/16 | .766 | 2.60 | 5¾ | 38 | 13/16 | .879 | 2.99 | 4¼ | 20 |
| 5 | 1.295 | 6 | 1 | 1.000 | 3.40 | 4¾ | 29 | | | | | |
| 5¼ | 1.515 | 5½ | 1 1/16 | 1.129 | 3.84 | 5¼ | 34 | 1⅛ | 1.266 | 4.30 | 4¼ | 20 |
| 5¼ | 1.744 | 5 | 1 3/16 | 1.410 | 4.80 | 4¾ | 24 | | | | | |
| 5½ | 2.048 | 5 | 1¼ | 1.563 | 5.31 | 5¼ | 31 | 1 5/16 | 1.723 | 5.86 | 4¼ | 19 |
| 5½ | 2.302 | 4½ | 1 5/16 | 1.891 | 6.43 | 4¾ | 22 | | | | | |
| 5¾ | 2.650 | 4½ | 1 7/16 | 2.066 | 7.03 | 5¼ | 28 | 1½ | 2.250 | 7.65 | 4¼ | 18 |
| 5¾ | 3.023 | 4½ | 1 9/16 | 2.441 | 8.30 | 4¾ | 24 | | | | | |
| 6 | 3.419 | 4½ | 1 5/8 | 2.641 | 8.98 | 5 | 30 | 1 11/16 | 2.848 | 9.68 | 4¼ | 20 |
| 6 | 3.715 | 4 | 1 11/16 | 3.063 | 10.41 | 4¼ | 21 | | | | | |
| 6¼ | 4.155 | 4 | 1 13/16 | 3.285 | 11.17 | 5 | 26 | 1⅞ | 3.516 | 11.95 | 4¼ | 18 |
| 6¼ | 4.619 | 4 | 1 15/16 | 3.754 | 12.76 | 4¾ | 23 | | | | | |
| 6½ | 5.108 | 4 | 2 | 4.000 | 13.60 | 5 | 28 | 2 1/16 | 4.254 | 14.46 | 4¼ | 20 |
| 6½ | 5.428 | 3½ | 2⅛ | 4.516 | 15.35 | 4¼ | 20 | | | | | |
| 6¾ | 5.957 | 3½ | 2 3/16 | 4.785 | 16.27 | 5 | 24 | 2¼ | 5.063 | 17.22 | 4¼ | 18 |
| 6¾ | 6.510 | 3½ | 2 5/16 | 5.348 | 18.19 | 4¾ | 22 | | | | | |
| 7 | 7.087 | 3½ | 2⅜ | 5.641 | 19.18 | 5¼ | 26 | 2 7/16 | 5.941 | 20.20 | 4½ | 19 |
| 7 | 7.548 | 3½ | 2⅜ | 6.250 | 21.25 | 4¾ | 21 | | | | | |
| 7¼ | 8.171 | 3¼ | 2 9/16 | 6.566 | 22.33 | 5¼ | 24 | 2⅝ | 6.891 | 23.43 | 4½ | 19 |
| 7¼ | 8.641 | 3 | 2 11/16 | 7.223 | 24.56 | 4¾ | 20 | | | | | |
| 7½ | 9.305 | 3 | 2¾ | 7.563 | 25.00 | 5¼ | 23 | 2 13/16 | 7.910 | 26.90 | 4½ | 18 |
| 7½ | 9.993 | 3 | 2⅞ | 8.266 | 28.10 | 4¾ | 21 | | | | | |

Upset Ends of sizes given in first column are used with one or two sizes of bars as given in the two columns headed "Side of Square Bar. A."

Lengths of Upset Ends above are best adapted for use with Turnbuckles of standard length, six inches between heads, as shown on page 294. Lengths of Upset Ends for use with ordinary Right and Left Nuts, shown on page 295, may be one inch shorter than above. *Upset Ends* 3 1/16", 3 3/16", 3 5/16" and 3 7/16" diameter are odd sizes *which Right and Left Nuts* and Turnbuckles are not regularly made.

## UPSET SCREW ENDS FOR FLAT BARS.



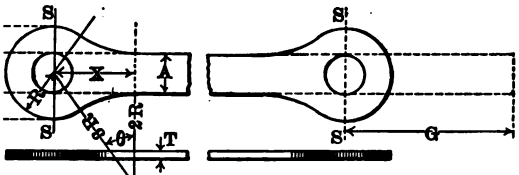

| Width of Bar. | Thickness of Bar. | Diameter of Upset of Bar. | Area of Bar. | Area at Root of Thread. | Length of Upset of Bar. | Add for Upset of E |
|---|---|---|---|---|---|---|
| A | T | B | | | G | |
| Inches. | Inches. | Inches. | Sq. Inches. | Sq. Inches. | Inches. | Inches. |
| 2 | 1 | 2 | 2.00 | 2.30 | 5½ | 6 |
| 3 | ⅞ | 2¼ | 2.63 | 3.023 | 6½ | 11½ |
| 3 | 1 | 2½ | 3.0 | 3.719 | 6½ | 11½ |
| 3 | 1⅛ | 2⅝ | 3.38 | 4.159 | 7 | 11¼ |
| 3 | 1¼ | 2¾ | 3.75 | 4.62 | 7 | 11 |
| 3 | 1⅜ | 2⅞ | 4.13 | 4.92 | 7 | 10 |
| 3 | 1½ | 3 | 4.50 | 5.43 | 7 | 10 |
| 4 | ⅝ | 2½ | 3.00 | 3.719 | 6½ | 12¾ |
| 4 | ¾ | 2⅝ | 3.50 | 4.159 | 7 | 12 |
| 4 | ⅞ | 2¾ | 4.00 | 4.62 | 7 | 11 |
| 4 | 1 | 3 | 4.50 | 5.43 | 7 | 11 |
| 4 | 1⅛ | 3¼ | 5.00 | 6.51 | 7½ | 11 |
| 4 | 1¼ | 3¼ | 5.50 | 6.51 | 7½ | 11 |
| 4 | 1⅜ | 3½ | 6.00 | 7.54 | 7½ | 10 |
| 4 | 1½ | 3½ | 6.50 | 7.54 | 7½ | 10 |
| 4 | 1⅝ | 3¾ | 7.00 | 8.64 | 7½ | 9½ |
| 5 | ¾ | 2¾ | 3.75 | 4.62 | 7 | 11 |
| 5 | ⅞ | 3 | 4.38 | 5.43 | 7 | 11 |
| 5 | 1 | 3¼ | 5.00 | 6.51 | 7½ | 10½ |
| 5 | 1⅛ | 3¼ | 5.63 | 6.51 | 7½ | 10½ |
| 5 | 1¼ | 3½ | 6.25 | 7.55 | 7½ | 9½ |
| 5 | 1⅜ | 3⅝ | 6.88 | 8.64 | 7½ | 9½ |
| 5 | 1½ | 3¾ | 7.50 | 8.64 | 7½ | 9¾ |
| 5 | 1⅝ | .. | 8.13 | 9.99 | .. | .. |
| 5 | 1¾ | .. | 8.75 | 9.99 | .. | .. |
| 6 | 1½ | 3¾ | 6.75 | 8.64 | 7½ | 10 9 |
| 6 | 1¼ | 3¾ | 7.50 | 8.64 | 7½ | |
| 6 | 1⅝ | .. | 8.25 | 9.99 | .. | .. |
| 6 | 1½ | .. | 9.00 | 9.99 | .. | .. |

For dimensions of heads corresponding to different-sized pins, see table of Bars on page 293.

Shortest length of bar permissible on account of method of manufacture from center to end.

The above length is used only for bars having heads 12⅛" diameter or less. *When* possible lengths of 7′ 0″ are preferred.

## STEEL EYE BARS.




Area of Excess to form one Head = Plane Area of Head − AX.

$$A_S = \frac{(180 + 2\theta)}{360}\,\pi R^2 + \left(4R^2 - \frac{A^2}{4}\right)\text{Tan.}\,\theta - .0698\,R^2\theta.$$

$$\cos\theta = \frac{2R + \frac{A}{2}}{3R}. \quad G = \frac{5A_S}{4A}.$$

Log. $\frac{\pi}{360} = 7.940848 - 10.$

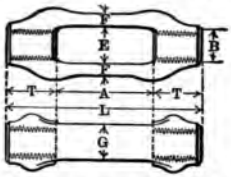
" $.0698 = 8.843855 - 10.$

| Minimum Thickness of Bar. | Diameter of Head of Bar. | Diameter of Largest Pin Hole. | Sectional Area of the Head on Line S—S in Excess of that in Body of Bar. | Additional Length of Bar Beyond Center of Eye Required to Form One Head. |
|---|---|---|---|---|
| T | E | D | | G |
| Inches. | Inches. | Inches. | | Inches. |
| .. | 4½ | 1⅞ | 33 % | 7½ |
| .. | 5⅞ | 2⅞ | " | 12½ |
| .. | 5½ | 2⅛ | " | 9⅛ |
| .. | 6⅛ | 3⅛ | " | 13⅛ |
| ⅜ | 6½ | 2⅛ | " | 10⅛ |
| ⅜ | 8 | 4 | " | 17½ |
| ⅜ | 9 | 5 | " | 22½ |
| ⅜ | 9½ | 4⅛ | " | 17½ |
| ½ | 10½ | 5⅛ | " | 21 |
| ½ | 11½ | 6⅛ | " | 27½ |
| ½ | 11½ | 4⅜ | 37 % | 20 |
| ½ | 12½ | 5⅜ | " | 24 |
| 1 | 13 | 6⅜ | " | 27½ |
| 1 | 14 | 7⅜ | " | 32 |
| ⅞ | 13½ | 5¼ | " | 21½ |
| ⅞ | 14⅞ | 6¼ | " | 27 |
| 1 | 15½ | 7¼ | " | 31½ |
| 1⅛ | 15½ | 5⅝ | 40 % | 26 |
| 1⅛ | 17 | 7⅛ | " | 32 |
| 1 | 17 | 5¾ | " | 25½ |
| 1 | 18 | 6¾ | " | 30½ |
| 1 | 19 | 8 | " | 35 |
| 1¼ | 19½ | 7 | " | 32½ |
| 1¼ | 21½ | 9 | " | 36½ |
| 1¼ | 22½ | 10 | .. | .. |
| 1⅜ | 24½ | 10⅝ | .. | .. |

of head given is the size of die. The size of finished head will overrun ⅛". Eye Bars are Hydraulic Forged without the addition of extraneous without buckles or welds. The heads on Eye Bars are finished of thickness "T" as body of bar.

# TURNBUCKLES.

## PRESSED WROUGHT IRON.



THE CLEVELAND CITY FORGE AND IRON CO.

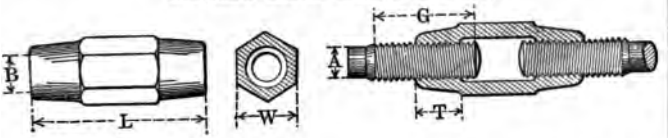
| Dimensions of Bar. | | | L | T | A | E | F | H |
|---|---|---|---|---|---|---|---|---|
| Diameter of Screw. B | Diameter of Bar. | Side of Square Bar. | | | | | | |
| Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| 3/8 | | | 7 1/8 | 9/16 | 6 | 9/16 | 3/16 | 1 |
| 7/16 | | | 7 5/16 | 21/32 | 6 | 5/8 | 1/4 | 1 |
| 1/2 | | | 7 1/2 | 3/4 | 6 | 5/8 | 1/4 | 1 |
| 9/16 | | | 7 11/16 | 27/32 | 6 | 11/16 | 1/4 | 1 |
| 5/8 | | | 7 7/8 | 13/16 | 6 | 11/16 | 1/4 | 1 |
| 5/8 | 1/2 and 9/16 | 1/2 | 8 1/4 | 1 1/8 | 6 | 1 1/16 | 5/16 | 2 |
| 3/4 | 5/8 " 3/4 | 9/16 and 11/16 | 8 5/8 | 1 1/8 | 6 | 1 1/4 | 3/8 | 2 |
| 7/8 | 11/16 " 3/4 | 3/4 | 9 | 1 1/2 | 6 | 1 3/8 | 7/16 | 2 |
| 1 | 13/16 " 1 | 7/8 | 9 3/8 | 1 11/16 | 6 | 1 5/16 | 1/2 | 2 |
| 1 1/8 | 1 1/16 " 1 1/8 | 1 " 1 1/16 | 9 3/4 | 1 7/8 | 6 | 1 7/16 | 1/2 | 2 |
| 1 1/4 | 1 1/4 " 1 5/16 | 1 1/8 " 1 3/16 | 10 1/8 | 2 1/16 | 6 | 1 9/16 | 5/8 | 3 |
| 1 3/8 | 1 3/8 " 1 7/16 | 1 1/4 " 1 5/16 | 10 1/2 | 2 1/4 | 6 | 1 11/16 | 5/8 | 3 |
| 1 1/2 | 1 1/2 " 1 5/8 | 1 3/8 " 1 7/16 | 10 7/8 | 2 7/16 | 6 | 2 | 5/8 | 3 |
| 1 5/8 | 1 5/8 " 1 3/4 | 1 1/2 " 1 5/8 | 11 1/4 | 2 5/8 | 6 | 2 1/8 | 5/8 | 3 |
| 1 3/4 | 1 13/16 " 1 7/8 | 1 11/16 " 1 3/4 | 11 5/8 | 2 13/16 | 6 | 2 3/16 | 11/16 | 3 |
| 1 7/8 | 1 15/16 " 2 | 1 13/16 " 1 7/8 | 12 | 3 | 6 | 2 5/16 | 11/16 | 4 |
| 2 | 2 1/16 " 2 1/8 | 1 15/16 " 2 | 12 3/8 | 3 3/16 | 6 | 2 7/16 | 11/16 | 4 |
| 2 1/8 | 2 3/16 " 2 1/4 | 2 1/16 " 2 1/8 | 12 3/4 | 3 5/16 | 6 | 2 1/2 | 11/16 | 4 |
| 2 1/4 | 2 5/16 " 2 3/8 | 2 3/16 " 2 1/4 | 13 1/8 | 3 1/2 | 6 | 2 5/8 | 11/16 | 4 |
| 2 3/8 | 2 7/16 " 2 1/2 | 2 5/16 " 2 3/8 | 13 1/2 | 3 5/8 | 6 | 2 3/4 | 11/16 | 5 |
| 2 1/2 | 2 9/16 " 2 5/8 | 2 7/16 " 2 1/2 | 13 7/8 | 3 11/16 | 6 | 2 7/8 | 11/16 | 5 |
| 2 5/8 | 2 11/16 " 2 3/4 | 2 9/16 " 2 5/8 | 14 1/4 | 3 13/16 | 6 | 2 15/16 | 11/16 | 5 |
| 2 3/4 | 2 13/16 " 2 7/8 | 2 11/16 " 2 3/4 | 14 5/8 | 4 | 6 | 3 1/16 | 11/16 | 6 |
| 2 7/8 | 2 15/16 " 3 | 2 13/16 " 2 7/8 | 15 | 4 1/8 | 6 | 3 1/4 | 1 1/32 | 6 |
| 3 | 3 1/16 " 3 1/8 | 2 15/16 " 3 | 15 3/4 | 4 5/16 | 6 | 3 3/8 | 1 1/32 | 6 |
| 3 1/4 | 3 3/16 " 3 5/16 | 3 1/16 " 3 1/8 | 16 1/2 | 4 1/2 | 6 | 3 1/2 | 1 1/32 | 7 |
| 3 1/2 | 3 7/16 " 3 9/16 | 3 3/16 " 3 5/16 | 17 1/4 | 4 11/16 | 6 | 3 5/8 | 1 1/32 | 7 |
| 3 3/4 | 3 11/16 " 3 13/16 | 3 7/16 " 3 9/16 | 18 | 4 7/8 | 6 | 3 7/8 | 1 1/32 | 8 |
| 4 | 3 15/16 " 4 1/16 | 3 11/16 " 3 13/16 | 21 1/4 | 5 3/4 | 9 | 4 1/8 | 1 1/32 | 9 |
| 4 1/4 | 4 3/16 " 4 5/16 | 3 15/16 " 4 1/16 | 22 1/2 | 6 1/8 | 9 | 4 3/8 | 1 1/32 | 10 |
| 4 1/2 | 4 7/16 " 4 9/16 | 4 3/16 " 4 5/16 | 23 1/2 | 6 3/8 | 9 | 4 5/8 | 1 1/32 | 10 |
| 4 3/4 | 4 11/16 " 4 13/16 | 4 7/16 " 4 9/16 | 24 1/2 | 6 5/8 | 9 | 4 7/8 | 1 1/32 | 11 |
| 5 | 4 15/16 " 5 1/16 | 4 11/16 " 4 13/16 | 25 1/2 | 6 7/8 | 9 | 5 1/8 | 1 1/32 | 11 |
| 5 1/4 | 5 3/16 " 5 5/16 | 4 15/16 " 5 1/16 | 26 1/2 | 7 1/8 | 9 | 5 3/8 | 1 1/32 | 12 |
| 5 1/2 | 5 7/16 " 5 9/16 | 5 3/16 " 5 5/16 | 27 1/2 | 7 3/8 | 9 | 5 5/8 | 1 1/32 | 12 |
| 5 3/4 | 5 11/16 " 5 13/16 | 5 7/16 " 5 9/16 | 28 1/2 | 7 5/8 | 9 | 5 7/8 | 1 1/32 | 12 |
| 6 | 5 15/16 " 6 1/16 | 5 11/16 " 5 13/16 | 29 1/2 | 7 7/8 | 9 | 6 1/8 | 1 1/32 | 12 |
| 6 1/4 | 6 3/16 " 6 5/16 | 5 15/16 " 6 1/16 | 30 1/2 | 8 1/8 | 9 | 6 3/8 | 1 1/32 | 12 |
| 6 1/2 | 6 7/16 " 6 9/16 | 6 3/16 " 6 5/16 | 31 1/2 | 8 3/8 | 9 | 6 5/8 | 1 1/32 | 12 |
| 6 3/4 | 6 11/16 " 6 13/16 | 6 7/16 " 6 9/16 | 32 1/2 | 8 5/8 | 9 | 6 7/8 | 1 1/32 | 12 |
| 7 | 6 15/16 " 7 1/16 | 6 11/16 " 6 13/16 | 33 1/2 | 8 7/8 | 9 | 7 1/8 | 1 1/32 | 12 |
| 7 1/4 | 7 3/16 " 7 5/16 | 6 15/16 " 7 1/16 | 34 1/2 | 9 1/8 | 9 | 7 3/8 | 1 1/32 | 12 |
| 7 1/2 | 7 7/16 " 7 9/16 | 7 3/16 " 7 5/16 | 35 1/2 | 9 3/8 | 9 | 7 5/8 | 1 1/32 | 12 |
| 7 3/4 | 7 11/16 " 7 13/16 | 7 7/16 " 7 9/16 | 36 1/2 | 9 5/8 | 9 | 7 7/8 | 1 1/32 | 12 |
| 8 | 7 15/16 " 8 1/16 | 7 11/16 " 7 13/16 | 37 1/2 | 9 7/8 | 9 | 8 1/8 | 1 1/32 | 12 |
| 8 1/4 | 8 3/16 " 8 5/16 | 7 15/16 " 8 1/16 | 38 1/2 | 10 1/8 | 9 | 8 3/8 | 1 1/32 | 12 |
| 8 1/2 | 8 7/16 " 8 9/16 | 8 3/16 " 8 5/16 | 39 1/2 | 10 3/8 | 9 | 8 5/8 | 1 1/32 | 12 |
| 8 3/4 | 8 11/16 " 8 13/16 | 8 7/16 " 8 9/16 | 40 1/2 | 10 5/8 | 9 | 8 7/8 | 1 1/32 | 12 |
| 9 | 8 15/16 " 9 1/16 | 8 11/16 " 8 13/16 | 41 1/2 | 10 7/8 | 9 | 9 1/8 | 1 1/32 | 12 |
| 9 1/4 | 9 3/16 " 9 5/16 | 8 15/16 " 9 1/16 | 42 1/2 | 11 1/8 | 9 | 9 3/8 | 1 1/32 | 12 |
| 9 1/2 | 9 7/16 " 9 9/16 | 9 3/16 " 9 5/16 | 43 1/2 | 11 3/8 | 9 | 9 5/8 | 1 1/32 | 12 |
| 9 3/4 | 9 11/16 " 9 13/16 | 9 7/16 " 9 9/16 | 44 1/2 | 11 5/8 | 9 | 9 7/8 | 1 1/32 | 12 |
| 10 | 9 15/16 " 10 1/16 | 9 11/16 " 9 13/16 | 45 1/2 | 11 7/8 | 9 | 10 1/8 | 1 1/32 | 12 |
| 10 1/4 | 10 3/16 " 10 5/16 | 9 15/16 " 10 1/16 | 46 1/2 | 12 1/8 | 9 | 10 3/8 | 1 1/32 | 12 |
| 10 1/2 | 10 7/16 " 10 9/16 | 10 3/16 " 10 5/16 | 47 1/2 | 12 3/8 | 9 | 10 5/8 | 1 1/32 | 12 |
| 10 3/4 | 10 11/16 " 10 13/16 | 10 7/16 " 10 9/16 | 48 1/2 | 12 5/8 | 9 | 10 7/8 | 1 1/32 | 12 |
| 11 | 10 15/16 " 11 1/16 | 10 11/16 " 10 13/16 | 49 1/2 | 12 7/8 | 9 | 11 1/8 | 1 1/32 | 12 |
| 11 1/4 | 11 3/16 " 11 5/16 | 10 15/16 " 11 1/16 | 50 1/2 | 13 1/8 | 9 | 11 3/8 | 1 1/32 | 12 |
| 11 1/2 | 11 7/16 " 11 9/16 | 11 3/16 " 11 5/16 | 51 1/2 | 13 3/8 | 9 | 11 5/8 | 1 1/32 | 12 |
| 11 3/4 | 11 11/16 " 11 13/16 | 11 7/16 " 11 9/16 | 52 1/2 | 13 5/8 | 9 | 11 7/8 | 1 1/32 | 12 |
| 12 | 11 15/16 " 12 1/16 | 11 11/16 " 11 13/16 | 53 1/2 | 13 7/8 | 9 | 12 1/8 | 1 1/32 | 12 |
| 12 1/4 | 12 3/16 " 12 5/16 | 11 15/16 " 12 1/16 | 54 1/2 | 14 1/8 | 9 | 12 3/8 | 1 1/32 | 12 |
| 12 1/2 | 12 7/16 " 12 9/16 | 12 3/16 " 12 5/16 | 55 1/2 | 14 3/8 | 9 | 12 5/8 | 1 1/32 | 12 |
| 12 3/4 | 12 11/16 " 12 13/16 | 12 7/16 " 12 9/16 | 56 1/2 | 14 5/8 | 9 | 12 7/8 | 1 1/32 | 12 |
| 13 | 12 15/16 " 13 1/16 | 12 11/16 " 12 13/16 | 57 1/2 | 14 7/8 | 9 | 13 1/8 | 1 1/32 | 12 |
| 13 1/4 | 13 3/16 " 13 5/16 | 12 15/16 " 13 1/16 | 58 1/2 | 15 1/8 | 9 | 13 3/8 | 1 1/32 | 12 |
| 13 1/2 | 13 7/16 " 13 9/16 | 13 3/16 " 13 5/16 | 59 1/2 | 15 3/8 | 9 | 13 5/8 | 1 1/32 | 12 |
| 13 3/4 | 13 11/16 " 13 13/16 | 13 7/16 " 13 9/16 | 60 1/2 | 15 5/8 | 9 | 13 7/8 | 1 1/32 | 12 |
| 14 | 13 15/16 " 14 1/16 | 13 11/16 " 13 13/16 | 61 1/2 | 15 7/8 | 9 | 14 1/8 | 1 1/32 | 12 |
| 14 1/4 | 14 3/16 " 14 5/16 | 13 15/16 " 14 1/16 | 62 1/2 | 16 1/8 | 9 | 14 3/8 | 1 1/32 | 12 |
| 14 1/2 | 14 7/16 " 14 9/16 | 14 3/16 " 14 5/16 | 63 1/2 | 16 3/8 | 9 | 14 5/8 | 1 1/32 | 12 |
| 14 3/4 | 14 11/16 " 14 13/16 | 14 7/16 " 14 9/16 | 64 1/2 | 16 5/8 | 9 | 14 7/8 | 1 1/32 | 12 |
| 15 | 14 15/16 " 15 1/16 | 14 11/16 " 14 13/16 | 65 1/2 | 16 7/8 | 9 | 15 1/8 | 1 1/32 | 12 |
| 15 1/4 | 15 3/16 " 15 5/16 | 14 15/16 " 15 1/16 | 66 1/2 | 17 1/8 | 9 | 15 3/8 | 1 1/32 | 12 |
| 15 1/2 | 15 7/16 " 15 9/16 | 15 3/16 " 15 5/16 | 67 1/2 | 17 3/8 | 9 | 15 5/8 | 1 1/32 | 12 |
| 15 3/4 | 15 11/16 " 15 13/16 | 15 7/16 " 15 9/16 | 68 1/2 | 17 5/8 | 9 | 15 7/8 | 1 1/32 | 12 |
| 16 | 15 15/16 " 16 1/16 | 15 11/16 " 15 13/16 | 69 1/2 | 17 7/8 | 9 | 16 1/8 | 1 1/32 | 12 |
| 16 1/4 | 16 3/16 " 16 5/16 | 15 15/16 " 16 1/16 | 70 1/2 | 18 1/8 | 9 | 16 3/8 | 1 1/32 | 12 |
| 16 1/2 | 16 7/16 " 16 9/16 | 16 3/16 " 16 5/16 | 71 1/2 | 18 3/8 | 9 | 16 5/8 | 1 1/32 | 12 |
| 16 3/4 | 16 11/16 " 16 13/16 | 16 7/16 " 16 9/16 | 72 1/2 | 18 5/8 | 9 | 16 7/8 | 1 1/32 | 12 |
| 17 | 16 15/16 " 17 1/16 | 16 11/16 " 16 13/16 | 73 1/2 | 18 7/8 | 9 | 17 1/8 | 1 1/32 | 12 |
| 17 1/4 | 17 3/16 " 17 5/16 | 16 15/16 " 17 1/16 | 74 1/2 | 19 1/8 | 9 | 17 3/8 | 1 1/32 | 12 |
| 17 1/2 | 17 7/16 " 17 9/16 | 17 3/16 " 17 5/16 | 75 1/2 | 19 3/8 | 9 | 17 5/8 | 1 1/32 | 12 |
| 17 3/4 | 17 11/16 " 17 13/16 | 17 7/16 " 17 9/16 | 76 1/2 | 19 5/8 | 9 | 17 7/8 | 1 1/32 | 12 |
| 18 | 17 15/16 " 18 1/16 | 17 11/16 " 17 13/16 | 77 1/2 | 19 7/8 | 9 | 18 1/8 | 1 1/32 | 12 |
| 18 1/4 | 18 3/16 " 18 5/16 | 17 15/16 " 18 1/16 | 78 1/2 | 20 1/8 | 9 | 18 3/8 | 1 1/32 | 12 |
| 18 1/2 | 18 7/16 " 18 9/16 | 18 3/16 " 18 5/16 | 79 1/2 | 20 3/8 | 9 | 18 5/8 | 1 1/32 | 12 |
| 18 3/4 | 18 11/16 " 18 13/16 | 18 7/16 " 18 9/16 | 80 1/2 | 20 5/8 | 9 | 18 7/8 | 1 1/32 | 12 |
| 19 | 18 15/16 " 19 1/16 | 18 11/16 " 18 13/16 | 81 1/2 | 20 7/8 | 9 | 19 1/8 | 1 1/32 | 12 |
| 19 1/4 | 19 3/16 " 19 5/16 | 18 15/16 " 19 1/16 | 82 1/2 | 21 1/8 | 9 | 19 3/8 | 1 1/32 | 12 |
| 19 1/2 | 19 7/16 " 19 9/16 | 19 3/16 " 19 5/16 | 83 1/2 | 21 3/8 | 9 | 19 5/8 | 1 1/32 | 12 |
| 19 3/4 | 19 11/16 " 19 13/16 | 19 7/16 " 19 9/16 | 84 1/2 | 21 5/8 | 9 | 19 7/8 | 1 1/32 | 12 |
| 20 | 19 15/16 " 20 1/16 | 19 11/16 " 19 13/16 | 85 1/2 | 21 7/8 | 9 | 20 1/8 | 1 1/32 | 12 |
| 20 1/4 | 20 3/16 " 20 5/16 | 19 15/16 " 20 1/16 | 86 1/2 | 22 1/8 | 9 | 20 3/8 | 1 1/32 | 12 |
| 20 1/2 | 20 7/16 " 20 9/16 | 20 3/16 " 20 5/16 | 87 1/2 | 22 3/8 | 9 | 20 5/8 | 1 1/32 | 12 |
| 20 3/4 | 20 11/16 " 20 13/16 | 20 7/16 " 20 9/16 | 88 1/2 | 22 5/8 | 9 | 20 7/8 | 1 1/32 | 12 |
| 21 | 20 15/16 " 21 1/16 | 20 11/16 " 20 13/16 | 89 1/2 | 22 7/8 | 9 | 21 1/8 | 1 1/32 | 12 |
| 21 1/4 | 21 3/16 " 21 5/16 | 20 15/16 " 21 1/16 | 90 1/2 | 23 1/8 | 9 | 21 3/8 | 1 1/32 | 12 |
| 21 1/2 | 21 7/16 " 21 9/16 | 21 3/16 " 21 5/16 | 91 1/2 | 23 3/8 | 9 | 21 5/8 | 1 1/32 | 12 |
| 21 3/4 | 21 11/16 " 21 13/16 | 21 7/16 " 21 9/16 | 92 1/2 | 23 5/8 | 9 | 21 7/8 | 1 1/32 | 12 |
| 22 | 21 15/16 " 22 1/16 | 21 11/16 " 21 13/16 | 93 1/2 | 23 7/8 | 9 | 22 1/8 | 1 1/32 | 12 |
| 22 1/4 | 22 3/16 " 22 5/16 | 21 15/16 " 22 1/16 | 94 1/2 | 24 1/8 | 9 | 22 3/8 | 1 1/32 | 12 |
| 22 1/2 | 22 7/16 " 22 9/16 | 22 3/16 " 22 5/16 | 95 1/2 | 24 3/8 | 9 | 22 5/8 | 1 1/32 | 12 |
| 22 3/4 | 22 11/16 " 22 13/16 | 22 7/16 " 22 9/16 | 96 1/2 | 24 5/8 | 9 | 22 7/8 | 1 1/32 | 12 |
| 23 | 22 15/16 " 23 1/16 | 22 11/16 " 22 13/16 | 97 1/2 | 24 7/8 | 9 | 23 1/8 | 1 1/32 | 12 |
| 23 1/4 | 23 3/16 " 23 5/16 | 22 15/16 " 23 1/16 | 98 1/2 | 25 1/8 | 9 | 23 3/8 | 1 1/32 | 12 |
| 23 1/2 | 23 7/16 " 23 9/16 | 23 3/16 " 23 5/16 | 99 1/2 | 25 3/8 | 9 | 23 5/8 | 1 1/32 | 12 |
| 23 3/4 | 23 11/16 " 23 13/16 | 23 7/16 " 23 9/16 | 100 1/2 | 25 5/8 | 9 | 23 7/8 | 1 1/32 | 12 |
| 24 | 23 15/16 " 24 1/16 | 23 11/16 " 23 13/16 | 101 1/2 | 25 7/8 | 9 | 24 1/8 | 1 1/32 | 12 |

Standard Lengths, 6, 9, 12, 15, 18, 24, 36, 48 and 72 inches between hea
all sizes.

Lengths of Upset Ends shown on pages 290 and 291 are those best a
use with Turnbuckles of Standard Lengths as above.

*Dimensions* E, F, G and H depend upon the specifications of the
*which the* Turnbuckles are to be used.

## RIGHT AND LEFT NUTS.




| Diameter of Screw. | Length of Upset. | Diameter of Bar. | Side of Square Bar. | Length of Nut. | Length of Thread. | Diameter of Hex. | Weight of One Nut. | Weight of One Nut and Two Screw Ends. |
|---|---|---|---|---|---|---|---|---|
| B | G | A | A | L | T | W | | |
| Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Pounds. | Pounds. |
| | | | | Ordinary Lengths. | | | | |
| $\frac{7}{8}$ | $4\frac{1}{2}$ | $\frac{5}{8}$ | $\frac{9}{16}$ | 6 | $1\frac{7}{16}$ | $1\frac{5}{8}$ | $1\frac{3}{4}$ | $4\frac{1}{4}$ |
| 1 | $4\frac{1}{2}$ | $\frac{11}{16}$ and $\frac{3}{4}$ | $\frac{11}{16}$ and $\frac{11}{16}$ | 6 | $1\frac{7}{16}$ | $1\frac{5}{8}$ | $1\frac{3}{4}$ | $4\frac{1}{4}$ |
| $1\frac{1}{8}$ | $4\frac{3}{4}$ | $\frac{13}{16}$ | $\frac{3}{4}$ | $6\frac{1}{2}$ | $1\frac{9}{16}$ | 2 | 3 | $7\frac{1}{2}$ |
| $1\frac{1}{4}$ | $4\frac{3}{4}$ | $\frac{7}{8}$ " $\frac{15}{16}$ | $\frac{13}{16}$ | $6\frac{1}{2}$ | $1\frac{9}{16}$ | 2 | 3 | $7\frac{1}{2}$ |
| $1\frac{3}{8}$ | 5 | 1 " $1\frac{1}{16}$ | $\frac{7}{8}$ " $\frac{15}{16}$ | 7 | $1\frac{11}{16}$ | $2\frac{3}{16}$ | $4\frac{3}{4}$ | $11\frac{3}{4}$ |
| $1\frac{1}{2}$ | 5 | $1\frac{1}{16}$ " $1\frac{3}{16}$ | 1 | 7 | $1\frac{11}{16}$ | $2\frac{3}{16}$ | $4\frac{3}{4}$ | $11\frac{3}{4}$ |
| $1\frac{5}{8}$ | $5\frac{1}{4}$ | $1\frac{1}{8}$ | $1\frac{1}{16}$ " $1\frac{1}{8}$ | $7\frac{1}{2}$ | $2\frac{1}{16}$ | $2\frac{3}{16}$ | $6\frac{3}{4}$ | $16\frac{3}{4}$ |
| $1\frac{3}{4}$ | $5\frac{1}{4}$ | $1\frac{5}{16}$ " $1\frac{3}{8}$ | $1\frac{3}{16}$ " $1\frac{5}{16}$ | $7\frac{1}{2}$ | $2\frac{1}{16}$ | $2\frac{3}{16}$ | $6\frac{3}{4}$ | $16\frac{3}{4}$ |
| $1\frac{7}{8}$ | $5\frac{1}{2}$ | $1\frac{7}{16}$ | $1\frac{1}{4}$ | 8 | $2\frac{5}{16}$ | $3\frac{1}{4}$ | $9\frac{1}{4}$ | $23\frac{1}{4}$ |
| 2 | $5\frac{1}{2}$ | $1\frac{1}{2}$ " $1\frac{9}{16}$ | $1\frac{5}{16}$ | 8 | $2\frac{5}{16}$ | $3\frac{1}{4}$ | $9\frac{1}{4}$ | $23\frac{1}{4}$ |
| $2\frac{1}{8}$ | $5\frac{3}{4}$ | $1\frac{5}{8}$ " $1\frac{11}{16}$ | $1\frac{7}{16}$ " $1\frac{1}{2}$ | $8\frac{1}{2}$ | $2\frac{1}{2}$ | $3\frac{1}{2}$ | $12\frac{1}{2}$ | $31\frac{1}{2}$ |
| $2\frac{1}{4}$ | $5\frac{3}{4}$ | $1\frac{3}{4}$ " $1\frac{13}{16}$ | $1\frac{9}{16}$ " $1\frac{11}{16}$ | $8\frac{1}{2}$ | $2\frac{1}{2}$ | $3\frac{1}{2}$ | $12\frac{1}{2}$ | $31\frac{1}{2}$ |
| $2\frac{3}{8}$ | 6 | $1\frac{7}{8}$ | $1\frac{5}{8}$ " $1\frac{11}{16}$ | 9 | $2\frac{5}{8}$ | $3\frac{7}{8}$ | $16\frac{3}{4}$ | $41\frac{3}{4}$ |
| $2\frac{1}{2}$ | 6 | $1\frac{15}{16}$ " 2 | $1\frac{3}{4}$ " $1\frac{7}{8}$ | 9 | $2\frac{5}{8}$ | $3\frac{7}{8}$ | $16\frac{3}{4}$ | $41\frac{3}{4}$ |
| $2\frac{5}{8}$ | $6\frac{1}{4}$ | $2\frac{1}{16}$ " $2\frac{1}{8}$ | $1\frac{13}{16}$ " $1\frac{7}{8}$ | $9\frac{1}{2}$ | $2\frac{5}{8}$ | $4\frac{1}{4}$ | $21\frac{1}{2}$ | $53\frac{1}{4}$ |
| $2\frac{3}{4}$ | $6\frac{1}{4}$ | $2\frac{3}{16}$ | $1\frac{15}{16}$ | $9\frac{1}{2}$ | $2\frac{5}{8}$ | $4\frac{1}{4}$ | $21\frac{1}{2}$ | $53\frac{1}{4}$ |
| $2\frac{7}{8}$ | $6\frac{1}{2}$ | $2\frac{1}{4}$ " $2\frac{5}{16}$ | 2 " $2\frac{1}{16}$ | 10 | $3\frac{3}{16}$ | $4\frac{5}{8}$ | $26\frac{1}{2}$ | $66\frac{1}{4}$ |
| 3 | $6\frac{1}{2}$ | $2\frac{3}{8}$ | $2\frac{1}{8}$ | 10 | $3\frac{3}{16}$ | $4\frac{5}{8}$ | $26\frac{1}{2}$ | $66\frac{1}{4}$ |
| $3\frac{1}{4}$ | $6\frac{3}{4}$ | $2\frac{9}{16}$ " $2\frac{5}{8}$ | $2\frac{5}{16}$ | $10\frac{1}{2}$ | $3\frac{3}{8}$ | 5 | 32 | 81 |
| $3\frac{1}{2}$ | 7 | $2\frac{13}{16}$ | $2\frac{1}{2}$ | 11 | $3\frac{3}{8}$ | $5\frac{3}{8}$ | $38\frac{1}{4}$ | $97\frac{3}{4}$ |
| $3\frac{3}{4}$ | $7\frac{1}{4}$ | 3 | $2\frac{11}{16}$ | $11\frac{1}{2}$ | $3\frac{13}{16}$ | $5\frac{3}{4}$ | 45 | 116 |
| 4 | $7\frac{1}{2}$ | $3\frac{1}{4}$ | $2\frac{7}{8}$ | 12 | $4\frac{1}{16}$ | $6\frac{1}{8}$ | $53\frac{1}{2}$ | 138 |
| | | | | Extra Lengths. | | | | |
| $1\frac{1}{4}$ | $4\frac{3}{4}$ | $\frac{7}{8}$ " $\frac{15}{16}$ | $\frac{13}{16}$ | 12 | $2\frac{1}{16}$ | 2 | | |
| $1\frac{3}{8}$ | $4\frac{3}{4}$ | $\frac{13}{16}$ | $\frac{3}{4}$ | $8\frac{1}{2}$ | $1\frac{9}{16}$ | 2 | 4 | $9\frac{3}{4}$ |
| $1\frac{1}{2}$ | $4\frac{3}{4}$ | $\frac{7}{8}$ " $\frac{15}{16}$ | $\frac{13}{16}$ | $8\frac{1}{2}$ | $1\frac{9}{16}$ | 2 | 4 | $9\frac{3}{4}$ |
| $1\frac{5}{8}$ | 5 | 1 " $1\frac{1}{16}$ | $\frac{7}{8}$ " $\frac{15}{16}$ | 9 | $1\frac{11}{16}$ | $2\frac{3}{16}$ | $6\frac{1}{4}$ | $15\frac{1}{4}$ |
| $1\frac{3}{4}$ | 5 | $1\frac{1}{16}$ " $1\frac{3}{16}$ | 1 | 9 | $1\frac{11}{16}$ | $2\frac{3}{16}$ | $6\frac{1}{4}$ | $15\frac{1}{4}$ |
| $1\frac{7}{8}$ | $5\frac{1}{4}$ | $1\frac{1}{4}$ | $1\frac{1}{16}$ " $1\frac{1}{8}$ | $9\frac{1}{2}$ | $2\frac{1}{16}$ | $2\frac{3}{16}$ | $8\frac{3}{4}$ | $21\frac{1}{2}$ |
| $1\frac{7}{8}$ | $5\frac{1}{4}$ | $1\frac{5}{16}$ " $1\frac{3}{8}$ | $1\frac{3}{16}$ | $9\frac{1}{2}$ | $2\frac{1}{16}$ | $2\frac{3}{16}$ | $8\frac{3}{4}$ | $21\frac{1}{2}$ |
| $1\frac{7}{8}$ | $5\frac{1}{2}$ | $1\frac{7}{16}$ | $1\frac{1}{4}$ " $1\frac{5}{16}$ | 10 | $2\frac{1}{16}$ | $3\frac{1}{16}$ | $12\frac{1}{4}$ | $29\frac{3}{4}$ |
| 2 | $5\frac{1}{2}$ | $1\frac{1}{2}$ " $1\frac{9}{16}$ | $1\frac{5}{16}$ | 10 | $2\frac{5}{16}$ | $3\frac{1}{16}$ | $12\frac{1}{4}$ | $29\frac{3}{4}$ |

For Details of Upset Ends, see pages 290 and 291.

*Length of Upset Ends* for use with Right and Left Nuts may be made one inch shorter than the dimensions given in column "G" above.

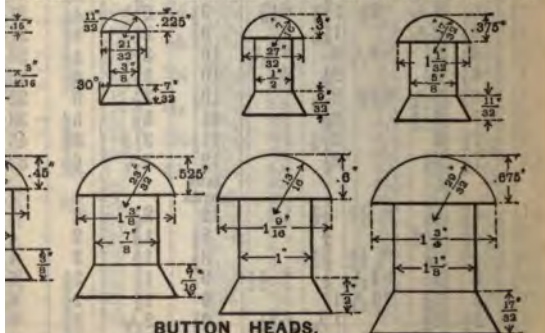
## CLEVISES.

EDGE MOOR BRIDGE WORKS' STANDARD.

| r | Side of Square Bar. | Diameter of Eye. | Length of Fork. | Diameter of Pin. | Length of Thread. | Width of Bar. | Thickness of Bar. | Width of Fork. | Weight of Clevises. | Weight of Clevis and Screw End. |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | E | L* | D* | T | W | X* | Z* | | |
| | Inches. | Ins. | Ins. | Inches. | Ins. | Ins. | Inches. | Ins. | Pounds. | Pounds. |
| | ⅝ | 4 | 5¼ | 1⅛ to 2⅛ | 1⅛ | 2 | ½ | 1⅛ | 5½ | 7¼ |
| ¼ | ⅝ & 1⅛ | 4 | 5¼ | 1⅛ " 2⅛ | 1⅛ | 2 | ½ | 1⅛ | 5½ | 7¼ |
| | ⅝ | 4 | 5¼ | 1⅛ " 2⅛ | 1⅛ | 2 | ½ | 1⅛ | 6½ | 8½ |
| | ¾ | 4 | 5¼ | 1⅛ " 2⅛ | 1⅛ | 2 | ½ | 1⅛ | 6½ | 8½ |
| ⅛ | 1⅛ " 1⅛ | 4 | 5¼ | 1⅛ " 2 | 1⅛ | 2 | ½ | 1⅛ | 7¼ | 10¼ |
| ⅛ | 1 | 4 | 5¼ | 1⅛ " 2 | 1⅛ | 2 | ½ | 1⅛ | 7¼ | 10¼ |
| | 1 1/16 " 1⅛ | 4 | 5¼ | 2 | 1¾ | 2 | ⅝ & ¾ | 1⅞ | 9 | 14 |
| ⅛ | 1⅛ | 4 | 5¼ | 2 | 1¾ | 2 | ⅝ " ¾ | 1⅞ | 9 | 14 |
| | 1⅛ " 1⅛ | 4⅞ | 7 | 2¼ | 2 | 2 | ¾ | 2⅛ | 13¾ | 20¼ |
| | 1⅛ | 4⅞ | 7 | 2¼ | 2 | 2 | ¾ | 2⅛ | 13¾ | 20¼ |
| | 1 1/16 " 1½ | 5⅞ | 7 | 2¼ | 2⅛ | 2⅛ | ¾ | 2⅜ | 20¼ | 29¾ |
| | 1⅛ | 5⅞ | 7 | 2½ | 2⅛ | 2⅛ | ¾ | 2⅜ | 20¼ | 29¾ |
| | 1⅛ " 1 11/16 | 6⅞ | 7 | 2⅝ | 2¼ | 2⅜ | ⅞ | 2⅝ | 25¼ | 37¼ |
| | 1⅛ | 6⅞ | 7 | 2¾ | 2¼ | 2½ | ⅞ | 2⅝ | 25¼ | 37¼ |
| ⅛ | 1⅛ " 1⅞ | 6⅞ | 8¼ | 3 | 2¾ | 3 | 1 | 2⅞ | | |
| | 1⅛ | 6⅞ | 8¼ | 3 | 2¾ | 3 | 1 | 2⅞ | | |

ions marked * may be varied somewhat if necessary. The minimum for each with the corresponding weight. Lengths of upset ends shown and 291.

## SIONS OF RIVET HEADS AFTER DRIVING.




### BUTTON HEADS.

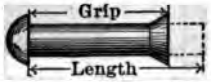
of Head = 9/10 × Diameter of Rivet. Radius of Head = ¾ Diameter 1/16".

### COUNTERSUNK HEADS.

r of Countersunk Head same as Button Head. Angle of Countersink figuring Clearances for Rivet Heads allow for Heights as follows: vets, ¾" for ⅞" rivets. All dimensions in inches.

CAMBRIA STEEL.

# LENGTH OF RIVETS REQUIRED FOR VARIO GRIPS INCLUDING AMOUNT NECESSARY TO FORM ONE HEAD.




Grip of Rivet in Inches.

**Diameter of Rivet in Inches.**

| 1/4″ | 3/8″ | 1/2″ | 5/8″ | 3/4″ | 7/8″ | 1″ | 1 |
|---|---|---|---|---|---|---|---|
| 1 | 1 1/4 | 1 1/4 | 1 3/4 | 1 7/8 | 2 | 2 1/8 | |
| 1 1/8 | 1 5/8 | 1 5/8 | 1 7/8 | 2 | 2 1/8 | 2 1/4 | |
| 1 1/4 | 1 1/2 | 1 3/4 | 2 | 2 1/8 | 2 1/4 | 2 3/8 | |
| 1 3/8 | 1 5/8 | 1 7/8 | 2 1/8 | 2 1/4 | 2 3/8 | 2 1/2 | |
| 1 1/2 | 1 3/4 | 2 | 2 1/4 | 2 3/8 | 2 1/2 | 2 5/8 | |
| 1 5/8 | 1 7/8 | 2 1/8 | 2 3/8 | 2 1/2 | 2 5/8 | 2 3/4 | |
| 1 3/4 | 2 | 2 1/4 | 2 1/2 | 2 5/8 | 2 3/4 | 2 7/8 | |
| 1 7/8 | 2 1/8 | 2 3/8 | 2 5/8 | 2 3/4 | 2 7/8 | 3 | |
| 2 | 2 1/4 | 2 1/2 | 2 3/4 | 2 7/8 | 3 | 3 1/8 | |
| 2 1/8 | 2 3/8 | 2 5/8 | 2 7/8 | 3 | 3 1/8 | 3 1/4 | |
| 2 1/4 | 2 1/2 | 2 3/4 | 3 | 3 1/8 | 3 1/4 | 3 3/8 | |
| 2 3/8 | 2 5/8 | 2 7/8 | 3 1/8 | 3 1/4 | 3 3/8 | 3 1/2 | |
| 2 1/2 | 2 3/4 | 3 | 3 1/4 | 3 3/8 | 3 1/2 | 3 5/8 | |
| 2 5/8 | 2 7/8 | 3 1/8 | 3 3/8 | 3 1/2 | 3 5/8 | 3 3/4 | |
| 2 3/4 | 3 | 3 1/4 | 3 1/2 | 3 5/8 | 3 3/4 | 3 7/8 | |
| 2 7/8 | 3 1/8 | 3 3/8 | 3 5/8 | 3 3/4 | 3 7/8 | 4 | |
| 3 | 3 1/4 | 3 1/2 | 3 3/4 | 3 7/8 | 4 | 4 1/8 | |
| 3 1/8 | 3 3/8 | 3 5/8 | 3 7/8 | 4 | 4 1/8 | 4 1/4 | |
| 3 1/4 | 3 1/2 | 3 3/4 | 4 | 4 1/8 | 4 1/4 | 4 3/8 | |
| 3 3/8 | 3 5/8 | 3 7/8 | 4 1/8 | 4 1/4 | 4 3/8 | 4 1/2 | |
| 3 1/2 | 3 3/4 | 4 | 4 1/4 | 4 3/8 | 4 1/2 | 4 5/8 | |
| 3 5/8 | 3 7/8 | 4 1/8 | 4 3/8 | 4 1/2 | 4 5/8 | 4 3/4 | |
| 3 3/4 | 4 | 4 1/4 | 4 1/2 | 4 5/8 | 4 3/4 | 4 7/8 | |
| 3 7/8 | 4 1/8 | 4 3/8 | 4 5/8 | 4 3/4 | 4 7/8 | 5 | |
| 4 | 4 1/4 | 4 1/2 | 4 3/4 | 4 7/8 | 5 | 5 1/8 | |
| 4 1/8 | 4 3/8 | 4 5/8 | 4 7/8 | 5 | 5 1/8 | 5 1/4 | |
| 4 1/4 | 4 1/2 | 4 3/4 | 5 | 5 1/8 | 5 1/4 | 5 3/8 | |
| 4 3/8 | 4 5/8 | 4 7/8 | 5 1/8 | 5 1/4 | 5 3/8 | 5 1/2 | |
| 4 1/2 | 4 3/4 | 5 | 5 1/4 | 5 3/8 | 5 1/2 | 5 5/8 | |
| 4 5/8 | 4 7/8 | 5 1/8 | 5 3/8 | 5 1/2 | 5 5/8 | 5 3/4 | |
| 4 3/4 | 5 | 5 1/4 | 5 1/2 | 5 5/8 | 5 3/4 | 5 7/8 | |
| 4 7/8 | 5 1/8 | 5 3/8 | 5 5/8 | 5 3/4 | 5 7/8 | 6 | |
| 5 | 5 1/4 | 5 1/2 | 5 3/4 | 5 7/8 | 6 | 6 1/8 | |
| 5 1/8 | 5 3/8 | 5 5/8 | 5 7/8 | 6 | 6 1/8 | 6 1/4 | |
| 5 1/4 | 5 1/2 | 5 3/4 | 6 | 6 1/8 | 6 1/4 | 6 3/8 | |
| 5 3/8 | 5 5/8 | 5 7/8 | 6 1/8 | 6 1/4 | 6 3/8 | 6 1/2 | |
| 5 1/2 | 5 3/4 | 6 | 6 1/4 | 6 3/8 | 6 1/2 | 6 5/8 | |
| 5 5/8 | 5 7/8 | 6 1/8 | 6 3/8 | 6 1/2 | 6 5/8 | 6 3/4 | |
| 5 3/4 | 6 | 6 1/4 | 6 1/2 | 6 5/8 | 6 3/4 | 6 7/8 | |
| 5 7/8 | 6 1/8 | 6 3/8 | 6 5/8 | 6 3/4 | 6 7/8 | 7 | |
| 6 | 6 1/4 | 6 1/2 | 6 3/4 | 6 7/8 | 7 | 7 1/8 | |
| 6 1/8 | 6 3/8 | 6 5/8 | 6 7/8 | 7 | 7 1/8 | 7 1/4 | |
| 6 1/4 | 6 1/2 | 6 3/4 | 7 | 7 1/8 | 7 1/4 | 7 3/8 | |
| 6 3/8 | 6 5/8 | 6 7/8 | 7 1/8 | 7 1/4 | 7 3/8 | 7 1/2 | |
| 6 1/2 | 6 3/4 | 7 | 7 1/4 | 7 3/8 | 7 1/2 | 7 5/8 | |
| 6 5/8 | 6 7/8 | 7 1/8 | 7 3/8 | 7 1/2 | 7 5/8 | 7 3/4 | |
| 6 3/4 | 7 | 7 1/4 | 7 1/2 | 7 5/8 | 7 3/4 | 7 7/8 | |
| 6 7/8 | 7 1/8 | 7 3/8 | 7 5/8 | 7 3/4 | 7 7/8 | 8 | |
| 7 | 7 1/4 | 7 1/2 | 7 3/4 | 7 7/8 | 8 | | |

**Amount in Inches to be subtracted from abov lengths for Countersunk Heads.**

| 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 7/8 | 15/16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|

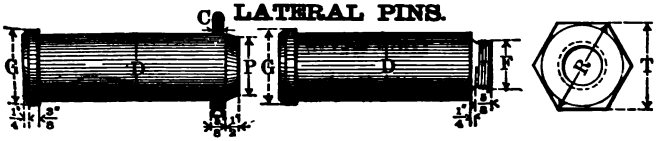
## BRIDGE PINS, NUTS AND PILOT NUTS

All Threads 8 per inch.

| Nominal Diameter of Pin. | Turned Diameter of Pin. | Diameter of Thread. | Short Diameter of Nut. | Long Diameter of Nut. | Di of in I |
|---|---|---|---|---|---|
| | D | F | A | G | |
| Inches. | Inches. | Inches. | Inches. | Inches. | |
| 1½ | 1 7/16 | 1¼ | 2 | 2 5/16 | D |
| 1¾ | 1 11/16 | 1½ | 2½ | 2⅞ | " |
| 2 | 1 15/16 | 1½ | 2½ | 2⅞ | " |
| 2¼ | 2 3/16 | 1½ | 3 | 3½ | " |
| 2½ | 2 7/16 | 2 | 3 | 3½ | " |
| 2¾ | 2 11/16 | 2 | 3½ | 4 1/16 | " |
| 3 | 2 15/16 | 2 | 3½ | 4 1/16 | " |
| 3¼ | 3 3/16 | 2½ | 4 | 4 11/16 | " |
| 3½ | 3 7/16 | 2½ | 4 | 4 11/16 | " |
| 3¾ | 3 11/16 | 2¾ | 4½ | 5 5/16 | " |
| 4 | 3 15/16 | 3 | 4½ | 5 5/16 | " |
| 4¼ | 4 3/16 | 3½ | 5 | 5 13/16 | " |
| 4½ | 4 7/16 | 3½ | 5 | 5 13/16 | " |
| 4¾ | 4 11/16 | 4 | 5½ | 6⅜ | " |
| 5 | 4 15/16 | 4 | 5½ | 6⅜ | " |
| 5¼ | 5 3/16 | 4 | 6 | 6 15/16 | " |
| 5½ | 5 7/16 | 4 | 6 | 6 15/16 | " |
| 5¾ | 5 11/16 | 4 | 6½ | 7½ | " |
| 6 | 5 15/16 | 4 | 6½ | 7½ | " |
| 6¼ | 6 3/16 | 4 | 7 | 8⅛ | " |
| 6½ | 6 7/16 | 4 | 7 | 8⅛ | " |
| 6¾ | 6 11/16 | 4 | 7½ | 8 11/16 | " |
| 7 | 6 15/16 | 4 | 7½ | 8 11/16 | " |

*Allow* 1/16" excess for each eye packed on the pin.

## LATERAL PINS.




| Rough Diameter of Pin. | Nominal Diameter of Pin. | Finished Diameter of Pin. | Reduced Point. | Short Diameter of Nut. | Long Diameter of Nut. | Diameter of Thread. | Diameter of Cotter Pin. |
|---|---|---|---|---|---|---|---|
| G | N | D | P | T | R | F | C |
| Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| 1 1/4 | 1 1/4 | 1 1/16 | 1 | 1 5/8 | 1 7/8 | 1 | 5/16 |
| 1 3/4 | 1 1/2 | 1 7/16 | 1 1/4 | 2 | 2 1/8 | 1 1/4 | " |
| 2 | 1 3/4 | 1 11/16 | 1 1/2 | 2 1/4 | 2 3/8 | 1 1/2 | " |
| 2 1/4 | 2 | 1 15/16 | 1 3/4 | 2 1/2 | 2 5/8 | 1 3/4 | " |
| 2 1/2 | 2 1/4 | 2 3/16 | 2 | 2 3/4 | 2 7/8 | 1 7/8 | 3/8 |
| 2 3/4 | 2 1/2 | 2 7/16 | 2 1/4 | 3 1/8 | 4 1/8 | 2 | " |
| 3 | 2 3/4 | 2 11/16 | 2 1/2 | 3 1/2 | 4 1/8 | 2 | " |
| 3 1/4 | 3 | 2 15/16 | 2 3/4 | 3 1/2 | 4 1/8 | 2 | " |
| 3 1/2 | 3 1/4 | 3 3/16 | 3 | 4 1/2 | 5 1/8 | 2 1/4 | " |
| 3 3/4 | 3 1/2 | 3 7/16 | 3 1/4 | 4 1/2 | 5 3/8 | 2 1/2 | " |
| 4 | 3 3/4 | 3 11/16 | 3 1/2 | 4 1/2 | 5 3/8 | 2 1/2 | " |

$D = G - \frac{5}{16}$". $P = N - \frac{1}{4}$".

## COUNTER AND LATERAL RODS.
## SOLID OR UPSET EYES.

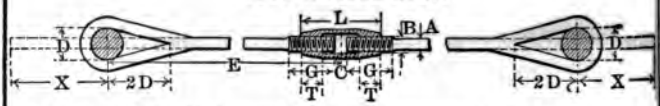
ROUND BARS. SQUARE BARS.

| Diameter of Bar. | Diameter of Largest Head. | Diameter of Largest Pin. | Add for One Head. | Side of Square Bar. | Diameter of Largest Head. | Diameter of Largest Pin. | Add for One Head. |
|---|---|---|---|---|---|---|---|
| A | E | D | | A | E | D | |
| Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. | Inches. |
| 7/8 | 2 1/4 | 1 1/4 | 9 | 1 | 4 1/4 | 2 1/4 | 16 |
| 1 | 4 1/4 | 2 1/2 | 18 | 1 1/8 | 4 1/4 | 2 1/2 | 14 |
| 1 1/8 | 4 1/4 | 2 1/2 | 16 | 1 1/4 | 5 | 2 3/4 | 18 1/2 |
| 1 1/4 | 5 | 2 3/4 | 20 1/2 | 1 3/8 | 5 | 2 3/4 | 16 1/2 |
| 1 3/8 | 5 | 2 3/4 | 18 1/2 | 1 1/2 | 5 1/2 | 3 | 18 |
| 1 1/2 | 5 1/2 | 3 | 20 | 1 5/8 | 5 1/2 | 3 | 16 1/2 |
| 1 5/8 | 5 1/2 | 3 | 18 1/2 | 1 3/4 | 6 | 3 1/4 | 18 |
| 1 3/4 | 6 | 3 1/4 | 21 | 1 7/8 | 6 | 3 1/4 | 16 1/2 |
| 1 7/8 | 6 | 3 1/4 | 19 1/2 | 2 | 6 1/2 | 3 1/2 | 18 1/2 |
| 2 | 6 1/2 | 3 1/2 | 21 1/2 | 2 1/8 | 6 1/2 | 3 1/2 | 17 |
| 2 1/4 | 6 1/2 | 3 1/2 | 20 | 2 1/4 | 7 1/2 | 4 | 21 1/2 |
| 2 1/4 | 7 1/2 | 4 | 24 1/2 | 2 3/8 | 7 1/2 | 4 | 19 3/4 |
| 2 3/8 | 7 1/2 | 4 | 22 3/4 | 2 1/2 | 8 | 4 | 22 1/2 |
| 2 1/2 | 8 | 4 | 25 1/2 | 2 5/8 | 8 | 4 | 21 |
| 2 5/8 | 8 | 4 | 24 | 2 3/4 | 8 | 4 | 19 1/2 |
| 2 3/4 | 8 | 4 | 22 1/2 | 1 1/2 | 5 1/2 | 3 3/16 | 23 |
| . . . | . . . | . . . | . . . | 1 1/4 | 5 1/2 | 3 3/16 | 23 |
| . . . | . . . | . . . | . . . | 1 3/8 | 5 3/4 | 3 3/16 | 20 |
| . . . | . . . | . . . | . . . | 1 1/4 | 6 | 3 3/16 | 20 |
| . . . | . . . | . . . | . . . | 7/8 | 3 1/2 | 2 1/4 | |
| . . . | . . . | . . . | . . . | 1 1/16 | 4 1/2 | 2 1/2 | 18 |

*For details of upset screw ends for round and square bars see pages 290 and 28*

# COUNTER AND LATERAL RODS.

## LOOP WELDED EYES.




Additional length of bar beyond center of pin required to make eye for square or round bars.

| Diameter or Side of Bar, Inches. | Diameter of Pin in Inches. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ¾ | 1 | 1¼ | 1½ | 1¾ | 2 | 2¼ | 2½ | 2¾ | 3 | 3¼ |
| ½ | 5⅜ | 6⅜ | 7⅜ | 8⅜ | 9⅜ | 10⅜ | 11⅜ | 12⅜ | 13⅜ | 14 | 15 |
| 9/16 | 6⅛ | 7⅛ | 8 | 9 | 10 | 10⅞ | 11⅞ | 12⅞ | 13⅞ | 14½ | 15½ |
| ⅝ | 6¾ | 7¾ | 8¾ | 9¾ | 10¾ | 11¾ | 12¾ | 13¾ | 14 | 15 | 16 |
| 11/16 | .... | 8 | 9 | 10 | 10¾ | 11¾ | 12¾ | 13½ | 14½ | 15½ | 16½ |
| ¾ | .... | 8½ | 9½ | 10⅛ | 11⅛ | 12⅛ | 13⅛ | 14 | 15 | 16 | 16⅝ |
| 13/16 | .... | .... | 10 | 10¾ | 11⅝ | 12⅝ | 13½ | 14½ | 15½ | 16½ | 17½ |
| ⅞ | .... | .... | 10¼ | 11¼ | 12⅜ | 13⅜ | 14 | 15 | 16 | 16¾ | 17⅜ |
| 15/16 | .... | .... | .... | 11¾ | 12⅝ | 13⅝ | 14½ | 15½ | 16½ | 17¼ | 18¼ |
| 1 | .... | .... | .... | 12¼ | 13⅛ | 14 | 15 | 16 | 16⅞ | 17⅞ | 18⅞ |
| 1 1/16 | .... | .... | .... | .... | 13½ | 14½ | 15½ | 16½ | 17¼ | 18¼ | 19¼ |
| 1⅛ | .... | .... | .... | .... | 14 | 15 | 16 | 16⅞ | 17⅞ | 18⅞ | 19⅞ |
| 1 3/16 | .... | .... | .... | .... | .... | 15½ | 16½ | 17¼ | 18¼ | 19¼ | 20 |
| 2 | .... | .... | .... | .... | .... | 16 | 16¾ | 17⅞ | 18⅞ | 19½ | 20½ |
| 2 1/16 | .... | .... | .... | .... | .... | .... | 17¼ | 18½ | 19½ | 20½ | 21 |
| 2⅛ | .... | .... | .... | .... | .... | .... | 18 | 18¾ | 19¾ | 20¾ | 21½ |
| 2 3/16 | .... | .... | .... | .... | .... | .... | .... | 19¼ | 20¼ | 21¼ | 22 |
| 2¼ | .... | .... | .... | .... | .... | .... | .... | 19¾ | 20⅜ | 21⅜ | 22⅜ |
| 2 5/16 | .... | .... | .... | .... | .... | .... | .... | .... | 21⅛ | 22⅛ | 23⅛ |
| 2⅜ | .... | .... | .... | .... | .... | .... | .... | .... | 21¾ | 22¾ | 23¾ |
| 2 7/16 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 23¼ | 24¼ |
| 3 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 23¾ | 24¾ |
| 3 1/16 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 25⅛ |
| 3¼ | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 25¾ |

Length in inches beyond center of pin required to form one eye = X.

FORMULÆ: When $\frac{A}{2}$ = or < 1

$$X = 3.7\,[D + A] + 1$$

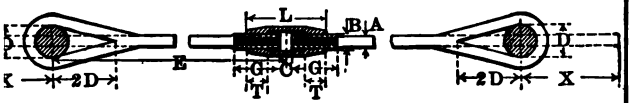
When $\frac{A}{2} > 1$

$$X = 3.7\,[D + A] + \frac{A}{2}$$

A = Side or Diameter of Bar.
D = Diameter of Pin.
Length of bar including amount required to form one eye = E − ½C + X.

# COUNTER AND LATERAL RODS.

## LOOP WELDED EYES.




ldditional length of bar beyond center of pin required to make eye for square or d bars.

| ıter de ır, es. | Diameter of Pin in Inches. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3½ | 3¾ | 4 | 4¼ | 4½ | 4¾ | 5 | 5¼ | 5½ | 5¾ | 6 |
| | 16 | 16⅜ | 17⅜ | 18⅜ | 19½ | 20½ | 21½ | 22½ | 23½ | 24½ | 25½ |
| | 16½ | 17¼ | 18¼ | 19¼ | 20 | 21 | 22 | 22⅝ | 23⅝ | 24⅝ | 25⅝ |
| | 16⅝ | 17⅜ | 18⅜ | 19½ | 20½ | 21½ | 22½ | 23¼ | 24¼ | 25¼ | 26 |
| | 17¼ | 18¼ | 19¼ | 20 | 21 | 22 | 22⅝ | 23⅝ | 24⅝ | 25⅝ | 26½ |
| | 17⅜ | 18⅜ | 19½ | 20½ | 21½ | 22½ | 23¼ | 24¼ | 25½ | 26 | 27 |
| | 18¼ | 19¼ | 20 | 21 | 22 | 22⅝ | 23⅝ | 24⅝ | 25⅝ | 26½ | 27½ |
| | 18⅜ | 19½ | 20½ | 21½ | 22½ | 23¼ | 24¼ | 25½ | 26 | 27 | 28 |
| | 19¼ | 20 | 21 | 22 | 22⅝ | 23⅝ | 24⅝ | 25⅝ | 26½ | 27½ | 28½ |
| | 19½ | 20½ | 21½ | 22½ | 23¼ | 24¼ | 25¼ | 26 | 27 | 28 | 28⅝ |
| | 20 | 21 | 22 | 22⅝ | 23⅝ | 24⅝ | 25⅝ | 26½ | 27½ | 28½ | 29¼ |
| | 20½ | 21½ | 22½ | 23¼ | 24¼ | 25½ | 26 | 27 | 28 | 28⅝ | 29¾ |
| | 21 | 22 | 22⅝ | 23⅝ | 24⅝ | 25⅝ | 26½ | 27½ | 28½ | 29¼ | 30¼ |
| | 21½ | 22½ | 23¼ | 24¼ | 25¼ | 26 | 27 | 28 | 28⅝ | 29⅝ | 30¾ |
| | 22 | 23 | 23⅝ | 24⅝ | 25⅝ | 26½ | 27½ | 28½ | 29½ | 30¼ | 31¼ |
| | 22½ | 23½ | 24¼ | 25¼ | 26¼ | 27¼ | 28 | 29 | 30 | 30⅝ | 31¾ |
| | 23 | 24 | 25 | 25⅝ | 26⅝ | 27¾ | 28½ | 29½ | 30½ | 31¼ | 32¼ |
| | 23½ | 24½ | 25½ | 26¼ | 27¼ | 28¼ | 29 | 30 | 31 | 32 | 32¾ |
| | 24 | 25 | 26 | 26⅝ | 27⅝ | 28⅝ | 29¾ | 30½ | 31½ | 32½ | 33¼ |
| | 24½ | 25½ | 26½ | 27½ | 28¼ | 29¼ | 30¼ | 31 | 32 | 33 | 33⅝ |
| | 25¼ | 26 | 27 | 28 | 28⅝ | 29⅝ | 30¾ | 31½ | 32½ | 33½ | 34½ |
| | 25⅜ | 26½ | 27½ | 28½ | 29¼ | 30¼ | 31¼ | 32⅛ | 33 | 34 | 35 |
| | 26¼ | 27 | 28 | 29 | 30 | 30⅝ | 31⅝ | 32⅝ | 33½ | 34½ | 35½ |
| | 26⅜ | 27⅜ | 28½ | 29½ | 30½ | 31¼ | 32¼ | 33⅛ | 34 | 35 | 36 |
| | 27¼ | 28¼ | 29 | 30 | 31 | 31⅝ | 32⅝ | 33⅝ | 34⅝ | 35½ | 36½ |
| | 27¾ | 28¾ | 29½ | 30½ | 31½ | 32½ | 33¼ | 34¼ | 35¼ | 36 | 37 |

or additional length required to form upset end and details of same see tables of ıet Ends, pages 290 and 291.
or details of Turnbuckles, see page 294.
*or details of Right and Left Nuts,* see page 295.

# STANDARD STEEL WIRE NAILS AND SPI

**Sizes, Lengths and Approximate Number per Pound.**

| Sizes. | Length. | COMMON. Diameter. B. W. G. | Diameter. Inches. | No. per Pound. | Barbed Common. | Clinch. | Fence. | Finishing. | Barbed Finishing. | Fine. | Barrel. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | ¾ | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 940 |
| | ⅞ | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 804 |
| 2d . . . | 1 | 15 | .072 | 900 | 860 | 622 | . . | 1558 | 1558 | 1440 | 620 |
| 3d Fine. | 1¼ | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 810 | 596 |
| 3d Com. | 1¼ | 14 | .083 | 615 | 594 | 412 | . . | 884 | 884 | . . | 542 |
| | 1½ | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 365 |
| 4d . . . | 1½ | 12½ | .102 | 322 | 339 | 267 | . . | 767 | 767 | 550 | 322 |
| 5d . . . | 1¾ | 12½ | .102 | 250 | 230 | 230 | 127 | 491 | 491 | . . | . . |
| 6d . . . | 2 | 11½ | .115 | 200 | 205 | 158 | 114 | 359 | 359 | . . | . . |
| 7d . . . | 2¼ | 11½ | .115 | 154 | 135 | 110 | 88 | 317 | 317 | . . | . . |
| 8d . . . | 2½ | 10¼ | .124 | 106 | 96 | 98 | 74 | 214 | 214 | . . | . . |
| 9d . . . | 2¾ | 10¼ | .124 | 85 | 92 | 86 | 58 | 195 | 195 | . . | . . |
| 10d . . . | 3 | 9 | .148 | 74 | 63 | 66 | 42 | 134 | 134 | . . | . . |
| 12d . . . | 3¼ | 9 | .148 | 57 | 52 | 57 | 36 | 120 | 120 | . . | . . |
| 16d . . . | 3½ | 8 | .165 | 46 | 38 | 46 | 28 | 91 | 91 | . . | . . |
| 20d . . . | 4 | 6 | .203 | 29 | 30 | 35 | 22 | 61 | 61 | . . | . . |
| 30d . . . | 4½ | 5 | .220 | 23 | 23 | . . | . . | . . | . . | . . | . . |
| 40d . . . | 5 | 4 | .238 | 17 | 17 | . . | . . | . . | . . | . . | . . |
| 50d . . . | 5½ | 3 | .259 | 13½ | 13½ | . . | . . | . . | . . | . . | . . |
| 60d . . . | 6 | 2 | .284 | 10½ | 10½ | . . | . . | . . | . . | . . | . . |

| Sizes. | Length. | Barbed Box. | Flooring Brads. | Barbed Oval Head Car Nails. Light. | Heavy. | Slating. | Barbed Roofing. | Shingle. | Tobacco. | Lining. | WIRE Diameter B. W. G. | Inc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ¾ | . . | . . | . . | . . | . . | 648 | . . | . . | 1930 | . . | . . |
| | ⅞ | . . | . . | . . | . . | . . | 413 | . . | . . | 1660 | . . | . . |
| 2d . . . | 1 | 1000 | . . | . . | . . | 385 | 384 | . . | . . | 1440 | . . | . . |
| 3d Fine. | 1¼ | . . | . . | . . | . . | . . | 339 | . . | . . | . . | . . | . . |
| 3d Com. | 1¼ | 660 | . . | . . | . . | 230 | 231 | 380 | . . | . . | . . | . . |
| | 1⅜ | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| 4d . . . | 1½ | 550 | . . | 260 | 164 | 198 | 154 | 256 | 256 | . . | . . | . . |
| 5d . . . | 1¾ | 366 | . . | 134 | 103 | 125 | 135 | 226 | 226 | . . | . . | . . |
| 6d . . . | 2 | 250 | 151 | 119 | 91 | 112 | 90 | 200 | 145 | . . | . . | . . |
| 7d . . . | 2¼ | 236 | 136 | 85 | 73 | . . | . . | 130 | 130 | . . | . . | . . |
| 8d . . . | 2½ | 157 | 98 | 75 | 65 | . . | . . | 120 | 100 | . . | . . | . . |
| 9d . . . | 2¾ | 145 | 86 | 58 | 51 | . . | . . | 115 | 85 | . . | . . | . . |
| 10d . . . | 3 | 107 | 66 | 55 | 45 | . . | . . | 79 | 65 | . . | 6 | .2 |
| 12d . . . | 3¼ | 98 | 51 | 43 | 38 | . . | . . | . . | . . | . . | . . | . . |
| 16d . . . | 3½ | 65 | 40 | 39 | 34 | . . | . . | . . | . . | . . | 5 | .2 |
| 20d . . . | 4 | 45 | 29 | 31 | 26 | . . | . . | . . | . . | . . | 4 | .2 |
| 30d . . . | 4½ | 40 | . . | 27 | 23 | . . | . . | . . | . . | . . | 3 | .2 |
| 40d . . . | 5 | 30 | . . | 21 | 17 | . . | . . | . . | . . | . . | 2 | .2 |
| 50d . . . | 5½ | . . | . . | 18 | 14 | . . | . . | . . | . . | . . | 1 | .3 |
| 60d . . . | 6 | . . | . . | 15 | 13 | . . | . . | . . | . . | . . | 1 | .3 |
| | 6½ | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 7 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 8 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 9 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 10 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |
| | 12 | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . | . . |

# MISCELLANEOUS STEEL WIRE NAILS.

Approximate Number per Pound.

| Birmingham or Stubs' Iron Wire Gauge. | Diameter in Inches. | Lengths—Inches. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 3/16 | 1/4 | 5/16 | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/8 | 1 1/4 | 1 1/2 |
| 00 | .380 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . | . . | 33 | 27 |
| 3/8 | .375 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . | . . | 33 | 27 |
| 0 | .340 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | . . | . . | 34 | 29 |
| 1/8 | .313 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 57 | 50 | 45 | 38 |
| 2 | .284 | . . . | . . . | . . . | . . . | . . . | . . . | . . . | 65 | 58 | 52 | 44 |
| 3 | .259 | . . . | . . . | . . . | . . . | . . . | 100 | 87 | 76 | 67 | 60 | 50 |
| 4 | .238 | . . . | . . . | . . . | . . . | . . . | 120 | 104 | 90 | 80 | 72 | 60 |
| 5 | .220 | . . . | . . . | . . . | 211 | 169 | 141 | 121 | 106 | 94 | 85 | 71 |
| 6 | .203 | . . . | . . . | . . . | 247 | 197 | 164 | 141 | 123 | 111 | 99 | 82 |
| 7 | .180 | . . . | . . . | . . . | 299 | 239 | 200 | 171 | 149 | 133 | 120 | 100 |
| 8 | .165 | . . . | . . . | . . . | 345 | 275 | 229 | 197 | 172 | 153 | 137 | 115 |
| 9 | .148 | . . . | . . . | . . . | 414 | 331 | 276 | 236 | 207 | 184 | 165 | 138 |
| 10 | .134 | . . . | . . . | 663 | 496 | 397 | 333 | 283 | 248 | 220 | 198 | 165 |
| 11 | .120 | . . . | . . . | 837 | 628 | 502 | 418 | 359 | 314 | 279 | 251 | 209 |
| 12 | .109 | . . . | . . . | 1096 | 822 | 658 | 548 | 469 | 411 | 365 | 329 | 274 |
| 13 | .095 | . . . | . . . | 1429 | 1072 | 857 | 714 | 613 | 536 | 476 | 429 | 357 |
| 14 | .083 | . . . | 2840 | 1893 | 1420 | 1136 | 947 | 811 | 710 | 631 | 568 | 473 |
| 15 | .072 | . . . | 3504 | 2336 | 1752 | 1402 | 1168 | 1001 | 876 | 778 | 701 | 584 |
| 16 | .065 | . . . | 4571 | 3048 | 2280 | 1828 | 1523 | 1305 | 1143 | 1015 | 913 | 761 |
| 17 | .058 | . . . | 6233 | 4156 | 3116 | 2495 | 2077 | 1781 | 1558 | 1385 | 1246 | 1038 |
| 18 | .049 | . . . | 8276 | 5517 | 4138 | 3310 | 2758 | 2364 | 2069 | 1839 | 1655 | 1379 |
| 19 | .042 | . . . | 10668 | 7112 | 5334 | 4267 | 3556 | 2933 | 2667 | 2370 | 2133 | 1778 |
| 20 | .035 | 20000 | 15000 | 10000 | 7500 | 6000 | 5000 | 4400 | 3750 | 3333 | 3000 | |
| 21 | .032 | 23702 | 17777 | 11850 | 8888 | 7111 | 5926 | 5079 | 4444 | | | |
| 22 | .028 | 30476 | 22856 | 15237 | 11428 | 9143 | 7618 | | | | | |

| Birmingham Wire Gauge. | Diameter in Inches. | Lengths—Inches. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 3/4 | 2 | 2 1/4 | 2 1/2 | 2 3/4 | 3 | 3 1/2 | 4 | 4 1/2 | 5 | 6 | 7 | 8 | 9 | 10 |
| 00 | .380 | 23 | 20 | 18 | 16 | 15 | 14 | 12 | 10 | 9 | 8 | 7 | 6 | 5 | 4 1/2 | 4 |
| 3/8 | .375 | 23 | 20 | 18 | 16 | 15 | 14 | 12 | 10 | 9 | 8 | 7 | 6 | 5 | 4 1/2 | 4 |
| 0 | .340 | 25 | 21 | 19 | 17 | 16 | 15 | 13 | 11 | 10 | 9 | 8 | 7 | 5 1/2 | 5 | 4 1/2 |
| 1/8 | .313 | 32 | 28 | 25 | 23 | 21 | 19 | 16 | 14 | 13 | 11 | 10 | 8 | 7 | 6 | 5 1/2 |
| 2 | .284 | 37 | 32 | 29 | 26 | 24 | 22 | 19 | 16 | 14 | 13 | 11 | 9 | 8 | 7 | 6 1/2 |
| 3 | .259 | 43 | 38 | 34 | 30 | 28 | 25 | 22 | 19 | 17 | 15 | 13 | 11 | 10 | 8 | 7 1/2 |
| 4 | .238 | 51 | 45 | 40 | 36 | 33 | 30 | 26 | 23 | 20 | 18 | 15 | 13 | 11 | 10 | 9 |
| 5 | .220 | 60 | 53 | 47 | 42 | 39 | 35 | 30 | 26 | 24 | 21 | 18 | 15 | | | |
| 6 | .203 | 71 | 62 | 55 | 50 | 45 | 41 | 35 | 31 | 28 | 25 | 21 | 18 | | | |
| 7 | .180 | 85 | 75 | 67 | 60 | 54 | 50 | 43 | 37 | 33 | 30 | 25 | | | | |
| 8 | .165 | 98 | 86 | 76 | 69 | 62 | 57 | 49 | 43 | 39 | 35 | 29 | | | | |
| 9 | .148 | 118 | 103 | 92 | 82 | 75 | 69 | 59 | 52 | 46 | 41 | | | | | |
| 10 | .134 | 142 | 124 | 110 | 99 | 90 | 83 | 71 | 62 | 55 | 50 | | | | | |
| 11 | .120 | 179 | 157 | 139 | 125 | 114 | 105 | 90 | 79 | 70 | | Wire Gauge. | | 11 | | 12 |
| 12 | .109 | 235 | 204 | 182 | 164 | 149 | 137 | 117 | 103 | | | | | | | |
| 13 | .095 | 306 | 268 | 238 | 214 | 195 | 178 | 153 | | | | | | | | |
| 14 | .083 | 406 | 350 | 315 | 284 | 258 | 236 | | | | | | | | | |
| 15 | .072 | 500 | 438 | 389 | 350 | | | | | | | 00 | | 3 3/4 | | 3 1/4 |
| 16 | .065 | 653 | 571 | 508 | | | | | | | | 3/8 | | 3 3/4 | | 3 1/4 |
| 17 | .058 | 890 | 779 | | | | | | | | | 0 | | 4 | | 3 1/2 |
| 18 | .049 | 1182 | | | | | | | | | | 1/8 | | 5 | | 4 1/2 |
| | | | | | | | | | | | | 2 | | 6 | | 5 1/2 |

These approximate numbers are an average only, and the figures given may be varied either way, by changes in the dimensions of heads or points. Brads and no-head nails will run more to the pound than table shows, and large or thick-headed nails will run less.

# CUT STEEL NAILS AND SPIKES.

Sizes, Lengths and Approximate Number per Pound.

| Sizes. | Length. Inches. | Common. | Clinch. | Finishing. | Casing and Box. | Fencing. | Spikes |
|---|---|---|---|---|---|---|---|
| 2d | 1 | 740 | 400 | 1100 | | | |
| 3d | 1¼ | 460 | 260 | 880 | | | |
| 4d | 1½ | 280 | 180 | 530 | 420 | | |
| 5d | 1¾ | 210 | 125 | 350 | 300 | 100 | |
| 6d | 2 | 160 | 100 | 300 | 210 | 80 | |
| 7d | 2¼ | 120 | 80 | 210 | 180 | 60 | |
| 8d | 2½ | 88 | 68 | 168 | 130 | 52 | |
| 9d | 2¾ | 73 | 52 | 130 | 107 | 38 | |
| 10d | 3 | 60 | 48 | 104 | 88 | 26 | |
| 12d | 3¼ | 46 | 40 | 96 | 70 | 20 | |
| 16d | 3½ | 33 | 34 | 86 | 52 | 18 | 1 |
| 20d | 4 | 23 | 24 | 76 | 38 | 16 | 1 |
| 25d | 4¼ | 20 | .... | .... | .... | .... | |
| 30d | 4½ | 16½ | .... | .... | 30 | .... | |
| 40d | 5 | 12 | .... | .... | 26 | .... | |
| 50d | 5½ | 10 | .... | .... | 20 | .... | |
| 60d | 6 | 8 | .... | .... | 16 | .... | |
| | 6½ | .... | .... | .... | .... | .... | |
| | 7 | .... | .... | .... | .... | .... | |

| Sizes. | Length. Inches. | Barrel. | Light Barrel. | Slating. |
|---|---|---|---|---|
| | ⅝ | 750 | .... | .... |
| | ¾ | 600 | .... | .... |
| | ⅞ | 500 | .... | .... |
| 2d | 1 | 450 | .... | 340 |
| | 1⅛ | 310 | 400 | .... |
| 3d | 1¼ | 280 | 304 | 280 |
| | 1⅜ | 210 | .... | .... |
| 4d | 1½ | 190 | 224 | 220 |
| 5d | 1¾ | .... | .... | 180 |
| 6d | 2 | .... | .... | .... |
| 7d | 2¼ | .... | .... | .... |
| 8d | 2½ | .... | .... | .... |
| 9d | 2¾ | .... | .... | .... |
| 10d | 3 | .... | .... | .... |
| 12d | 3¼ | .... | .... | .... |
| 16d | 3½ | .... | .... | .... |

| Sizes. | Length. Inches. | Flat Grip. Fine. | Edge G Fine |
|---|---|---|---|
| | ¾ | 1462 | |
| | ⅞ | 1300 | |
| 2d | 1 | 1100 | 96 |
| 3d | 1⅛ | 800 | 75 |
| 4d | 1⅜ | 650 | 60 |

| Tobacco. | Brads. | Shing |
|---|---|---|
| 130 | | |
| 97 | 120 | |
| 85 | 94 | |
| 68 | 74 | 9 |
| 58 | 62 | 7 |
| 48 | 50 | 6 |
| .... | 40 | |
| .... | 27 | |

## SQUARE BOAT SPIKES.

**Approximate Number in a Keg of 200 Pounds.**

| Size. Inches. | Length of Spike—Inches. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 14 | 16 |
| ¼ | 3000 | 2375 | 2050 | 1825 | | | | | | | | |
| 5/16 | 1660 | 1360 | 1230 | 1175 | 990 | 880 | | | | | | |
| ⅜ | 1320 | 1140 | 940 | 800 | 650 | 600 | 525 | 475 | | | | |
| 7/16 | . . . | . . . | . . . | 600 | 590 | 510 | 400 | 360 | 320 | 230 | | |
| ½ | . . . | . . . | . . . | 450 | 375 | 335 | 300 | 275 | 260 | 240 | | |
| ⅝ | . . . | . . . | . . . | . . . | . . | 260 | 240 | 220 | 205 | 190 | 175 | 160 |

## RAILROAD SPIKES.

| Size Measured Under Head. Inches. | Average Number per Keg of 200 Pounds. | Quantity of Spikes per Mile of Single Track. Ties 2 feet c. to c. 4 Spikes per Tie. | | Rail Used. Weight per Yard. Pounds. |
|---|---|---|---|---|
| | | Pounds. | Kegs. | |
| 5½ × ⅝ | 300 | 7040 | 35⅕ | 75 to 100 |
| 5½ × 5/16 | 375 | 5870 | 29⅗ | 45 " 75 |
| 5 × 5/16 | 400 | 5170 | 26 | 40 " 56 |
| 5 × ½ | 450 | 4660 | 23⅓ | 35 " 40 |
| 4½ × ½ | 580 | 3960 | 20 | 30 " 35 |
| 4 × ½ | 600 | 3520 | 17⅗ | 25 " 35 |
| 4½ × 7/16 | 680 | 3110 | 15½ | 20 " 30 |
| 4 × 7/16 | 720 | 2910 | 14⅗ | 20 " 30 |
| 3½ × 7/16 | 900 | 2350 | 11 | 16 " 25 |
| 4 × ⅜ | 1000 | 2090 | 10⅓ | 16 " 25 |
| 3½ × ⅜ | 1190 | 1780 | 9 | 16 " 20 |
| 3 × ⅜ | 1240 | 1710 | 8⅗ | 16 " 20 |
| 2½ × ⅜ | 1342 | 1575 | 7⅞ | 8 " 16 |

## WROUGHT-IRON WELDED STEAM, GAS AND WATER PI

TABLE OF STANDARD SIZES AND DIMENSIONS BY AMERICAN TUBE AND IRO

| Nominal Inside Diameter. | Actual Inside Diameter. | Actual Outside Diameter. | Thickness. | Nominal Weight per Foot. | CIRCUMFERENCE. | | LENGTH PER S FOOT OF SUR | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Internal. | External. | Inside. | O |
| Inches. | Inches. | Inches. | Inches. | Pounds. | Inches. | Inches. | Feet. | |
| 1/8 | .27 | .405 | .07 | .24 | .84 | 1.27 | 14.15 | |
| 1/4 | .36 | .54 | .08 | .42 | 1.14 | 1.69 | 10.50 | |
| 3/8 | .49 | .675 | .09 | .56 | 1.55 | 2.12 | 7.67 | |
| 1/2 | .62 | .84 | .10 | .84 | 1.95 | 2.65 | 6.13 | |
| 3/4 | .82 | 1.05 | .11 | 1.12 | 2.58 | 3.29 | 4.63 | |
| 1 | 1.04 | 1.315 | .13 | 1.67 | 3.29 | 4.13 | 3.67 | |
| 1 1/4 | 1.38 | 1.66 | .14 | 2.24 | 4.33 | 5.21 | 2.76 | |
| 1 1/2 | 1.61 | 1.9 | .14 | 2.68 | 5.06 | 5.96 | 2.37 | |
| 2 | 2.06 | 2.375 | .15 | 3.61 | 6.49 | 7.46 | 1.84 | |
| 2 1/4 | 2.46 | 2.875 | .20 | 5.74 | 7.75 | 9.03 | 1.54 | |
| 3 | 3.06 | 3.5 | .21 | 7.54 | 9.63 | 10.96 | 1.24 | |
| 3 1/2 | 3.56 | 4. | .22 | 9.00 | 11.14 | 12.56 | 1.07 | |
| 4 | 4.02 | 4.5 | .23 | 10.66 | 12.64 | 14.13 | .94 | |
| 4 1/2 | 4.50 | 5. | .24 | 12.34 | 14.15 | 15.70 | .84 | |
| 5 | 5.04 | 5.56 | .25 | 14.50 | 15.84 | 17.47 | .75 | |
| 6 | 6.06 | 6.625 | .28 | 18.76 | 19.05 | 20.81 | .63 | |
| 7 | 7.02 | 7.625 | .30 | 23.27 | 22.06 | 23.95 | .54 | |
| 8 | 7.98 | 8.625 | .32 | 28.18 | 25.07 | 27.09 | .47 | |
| 9 | 9.00 | 9.625 | .34 | 33.70 | 28.27 | 30.43 | .42 | |
| 10 | 10.01 | 10.75 | .36 | 40.06 | 31.47 | 33.77 | .38 | |
| 11 | 11. | 11.75 | .37 | 45. | 34.55 | 36.91 | .34 | |
| 12 | 12. | 12.75 | .37 | 49.00 | 37.70 | 40.05 | .32 | |
| 13 | 13.25 | 14. | .37 | 54.00 | 41.62 | 43.98 | .29 | |
| 14 | 14.25 | 15. | .37 | 58.00 | 44.76 | 47.12 | .27 | |
| 15 | 15.40 | 16. | .28 | 66.00 | 48.48 | 50.26 | .25 | |
| 16 | 16.40 | 17. | .30 | 70.00 | 51.52 | 53.41 | .23 | |
| 17 | 17.30 | 18. | .34 | 75.00 | 54.41 | 56.55 | .22 | |

| Nominal Inside Diameter. | Internal Area. | External Area. | Length Containing 1 Cubic Foot. | No. of Threads per Inch. | Contents of One Foot in Length. | SOCKETS ON P Outside Diameter. | L |
|---|---|---|---|---|---|---|---|
| Inches. | Sq. Inches. | Sq. Inches. | Feet. | | Gallons. | Inches. | I |
| 1/8 | .06 | .12 | 2500. | 27 | .002 | .60 | |
| 1/4 | .10 | .22 | 1385. | 18 | .002 | .78 | |
| 3/8 | .19 | .35 | 751.5 | 18 | .005 | .91 | |
| 1/2 | .30 | .55 | 472.4 | 14 | .010 | 1.10 | |
| 3/4 | .53 | .86 | 270. | 14 | .023 | 1.34 | |
| 1 | .86 | 1.35 | 166.9 | 11 1/2 | .040 | 1.66 | |
| 1 1/4 | 1.49 | 3.16 | 96.25 | 11 1/2 | .063 | 2.00 | |
| 1 1/2 | 2.03 | 2.83 | 70.65 | 11 1/2 | .091 | 2.28 | |
| 2 | 3.35 | 4.43 | 42.36 | 11 1/2 | .163 | 2.81 | |
| 2 1/4 | 4.78 | 6.49 | 30.11 | 8 | .255 | 3.28 | |
| 3 | 7.38 | 9.62 | 19.49 | 8 | .367 | 4.02 | |
| 3 1/2 | 9.83 | 12.56 | 14.56 | 8 | .500 | 4.50 | |
| 4 | 12.73 | 15.90 | 11.31 | 8 | .652 | 5.10 | |
| 4 1/2 | 15.93 | 19.63 | 9.03 | 8 | .826 | 5.53 | |
| 5 | 19.99 | 24.29 | 7.20 | 8 | 1.02 | 6.25 | |
| 6 | 28.88 | 34.47 | 4.98 | 8 | 1.46 | 7.34 | |
| 7 | 38.73 | 45.66 | 3.72 | 8 | 2.00 | 8.34 | |
| 8 | 50.03 | 58.42 | 2.88 | 8 | 2.61 | 9.44 | |
| 9 | 63.63 | 73.71 | 2.26 | 8 | 3.30 | 10.47 | |
| 10 | 78.83 | 90.79 | 1.80 | 8 | 4.08 | 11.50 | |
| 11 | 95.03 | 108.43 | 1.50 | 8 | 4.93 | | |
| 12 | 113.09 | 127.67 | 1.27 | 8 | 5.87 | 13.78 | |
| 13 | 137.88 | 153.94 | 1.04 | 8 | 6.89 | | |
| 14 | 159.48 | 176.71 | .90 | 8 | 8.00 | | |
| 15 | 187.04 | 201.06 | .77 | 8 | 9.18 | | |
| 16 | 211.24 | 226.98 | .68 | 8 | 10.44 | | |
| 17 | 235.61 | 254.47 | .61 | 8 | 11.79 | | |

# MANUFACTURERS' STANDARD SPECIFICATIONS.

REVISED TO FEBRUARY 15, 1901.

## STRUCTURAL STEEL.

### PROCESS OF MANUFACTURE.

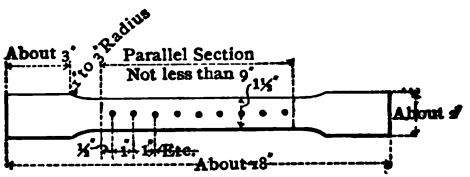
iteel may be made by either the Open-hearth or Bessemer s.

### TESTING.

ıll tests and inspections shall be made at the place of manufacrior to shipment.

### TEST PIECES.

'he tensile strength, limit of elasticity and ductility shall be deıed from a standard test piece cut from the finished material. tandard shape of the test piece for sheared plates shall be as ı by the following sketch:




Piece to be the same thickness as the plate.

tests cut from other material the test piece may be either the as for plates, or it may be planed or turned parallel throughout tire length. The elongation shall be measured on an original . of 8 inches, except when the thickness of the finished material ıch or less, in which case the elongation shall be measured in

length equal to sixteen times the thickness; and except in rou
⅝ inch or less in diameter, in which case the elongation shall be
ured in a length equal to eight times the diameter of section t
Two test pieces shall be taken from each melt or blow of fi
material, one for tension and one for bending.

### ANNEALED TEST PIECES.

3 *a*. Material which is to be used without annealing or f
treatment is to be tested in the condition in which it comes fr
rolls. When material is to be annealed or otherwise treated
use, the specimen representing such material is to be similarly t
before testing.

### MARKING.

4. Every finished piece of steel shall be stamped with the bl
melt number, and steel for pins shall have the blow or melt n
stamped on the ends. Rivet and lacing steel, and small pieces f
plates and stiffeners, may be shipped in bundles securely
together, with the blow or melt number on a metal tag attached.

### FINISH.

5. Finished bars must be free from injurious seams, flaws or c
and have a workmanlike finish.

### CHEMICAL PROPERTIES.

6. Steel for Buildings, Train Sheds, Highway Bridges and similar structures. } Maximum Phosphorus .10 per cen

7. Steel for Railway Bridges. } Maximum Phosphorus .08 per cen

### PHYSICAL PROPERTIES.

8. Structural steel shall be of three grades, RIVET, SOF
MEDIUM.

### RIVET STEEL.

9. Ultimate strength, 48 000 to 58 000 pounds per square inch.

Elastic limit, not less than one-half the ultimate strength.

Elongation, 26 per cent.

Bending test, 180 degrees flat on itself, without fracture on outside of bent portion.

### SOFT STEEL.

10. Ultimate strength, 52 000 to 62 000 pounds per square inch.

Elastic limit, not less than one-half the ultimate strength.

Elongation, 25 per cent.

Bending test, 180 degrees flat on itself, without fracture on outside of bent portion.

### MEDIUM STEEL.

11. Ultimate strength, 60 000 to 70 000 pounds per square inch.

Elastic limit, not less than one half the ultimate strength.

Elongation, 22 per cent.

Bending test, 180 degrees to a diameter equal to thickness of piece tested, without fracture on outside of bent portion.

### PIN STEEL.

12. Pins made from either of the above-mentioned grades of steel shall, on a specimen test piece cut at a depth of one inch from surface of finished material, fill the physical requirements of the grade of steel from which they are rolled, for ultimate strength, elastic limit, and bending, but the required elongation shall be decreased 5 per cent.

### EYE-BAR STEEL.

13. Eye-bar material, $1\frac{1}{2}$ inches and less in thickness, made of either of the above-mentioned grades of steel, shall, on test pieces cut from finished material, fill the requirements of the grade of steel from which it is rolled. For thicknesses greater than $1\frac{1}{2}$ inches, there will be allowed a reduction in the percentage of elongation of 1 per cent. for each $\frac{1}{8}$ of an inch increase of thickness, to a minimum of 20 per cent. *for medium steel and* 22 per cent. for soft steel.

### FULL SIZE TEST OF STEEL EYE-BARS.

14. Full size tests of steel eye-bars shall be required to show n than 10 per cent. elongation in the body of the bar, and tensile st not more than 5 000 pounds below the minimum tensile stren quired in specimen tests of the grade of steel from which th rolled. The bars will be required to break in the body, but sh bar break in the head, but develop 10 per cent. elongation a ultimate strength specified, it shall not be cause for rejection, pr not more than one-third of the total number of bars tested break head; otherwise the entire lot will be rejected.

### VARIATION IN WEIGHT.

15. The variation in cross-section or weight of more than 2½ pe from that specified will be sufficient cause for rejection, except case of sheared plates which will be covered by the following p sible variations:

*a.* Plates 12½ pounds per square foot, or heavier, up to 100 wide, when ordered to weight, shall not average more than 2½ pe variation above, or 2½ per cent. below the theoretical weight. 100 inches wide and over, 5 per cent. above, or 5 per cent. bel theoretical weight.

*b.* Plates under 12½ pounds per square foot, when ordered to v shall not average a greater variation than the following:

Up to 75 inches wide, 2½ per cent. above, or 2½ per cent. below th oretical weight. 75 inches wide up to 100 inches wide, 5 per cent. or 8 per cent. below the theoretical weight. When 100 inch and over, 10 per cent. above, or 8 per cent. below the theoretical

*c.* For all plates ordered to gauge, there will be permit *average* excess of weight over that corresponding to the dimens *he order* equal in amount to that specified in the following ta

## TABLE OF ALLOWANCES FOR OVERWEIGHT FOR RECTANGULAR PLATES WHEN ORDERED TO GAUGE.

**PLATES WILL BE CONSIDERED UP TO GAUGE IF MEASURING NOT OVER $\frac{1}{100}$ INCH LESS THAN THE ORDERED GAUGE.**

**THE WEIGHT OF 1 CUBIC INCH OF ROLLED STEEL IS ASSUMED TO BE 0.2833 POUNDS.**

PLATES $\frac{1}{4}''$ AND OVER IN THICKNESS.

| THICKNESS OF PLATE. | WIDTH OF PLATE. | | |
|---|---|---|---|
| | Up to 75 Inches. | 75 Inches to 100 Inches. | Over 100 Inches. |
| $\frac{1}{4}$ inch | 10 per cent. | 14 per cent. | 18 per cent. |
| $\frac{5}{16}$ " | 8 " | 12 " | 16 " |
| $\frac{3}{8}$ " | 7 " | 10 " | 13 " |
| $\frac{7}{16}$ " | 6 " | 8 " | 10 " |
| $\frac{1}{2}$ " | 5 " | 7 " | 9 " |
| $\frac{5}{16}$ " | $4\frac{1}{2}$ " | $6\frac{1}{2}$ " | $8\frac{1}{3}$ " |
| $\frac{3}{4}$ " | 4 " | 6 " | 8 " |
| Over $\frac{3}{4}$ " | $3\frac{1}{2}$ " | 5 " | $6\frac{1}{2}$ " |

PLATES UNDER $\frac{1}{4}''$ IN THICKNESS.

| THICKNESS OF PLATE. Inch. | WIDTH OF PLATE. | |
|---|---|---|
| | Up to 50 Inches. | 50 Inches and Over. |
| $\frac{1}{8}$ up to $\frac{5}{32}$ | 10 per cent. | 15 per cent. |
| $\frac{5}{32}$ " $\frac{3}{16}$ | $8\frac{1}{2}$ " | $12\frac{1}{2}$ " |
| $\frac{3}{16}$ " $\frac{1}{4}$ | 7 " | 10 " |

## STRUCTURAL CAST IRON.

1. Except when chilled iron is specified, all castings shall be tough gray iron, free from injurious cold-shuts or blow-holes, true to pattern, and of a workmanlike finish. Sample pieces, one inch square, cast from the same heat of metal in sand moulds, shall be capable of sustaining on a clear span of 4 feet 8 inches a central load of 500 pounds *when tested in the rough* bar.

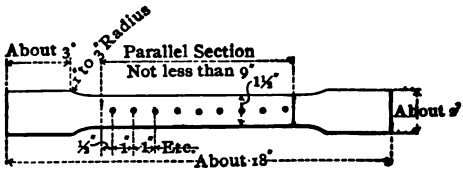
## SPECIAL OPEN-HEARTH PLATE AND RIVET STEEL.

### TESTING AND INSPECTION.

1. All tests and inspections shall be made at the place of manufacture prior to shipment.

### TEST PIECES.

2. The tensile strength, limit of elasticity and ductility, shall be determined from a standard test piece cut from the finished material. The standard shape of the test piece for sheared plates shall be as shown by the following sketch:




Piece to be the same thickness as the plate.

On tests cut from other material the test piece may be either the same as for plates, or it may be planed or turned parallel throughout its entire length. The elongation shall be measured on an original length of 8 inches, except when the thickness of the finished material is $\frac{5}{16}$ inch or less, in which case the elongation shall be measured in a length equal to sixteen times the thickness; and except in rounds of $\frac{5}{8}$ inch or less in diameter, in which case the elongation shall be measured in a length equal to eight times the diameter of section tested. Four test pieces shall be taken from each melt of finished material; two for tension and two for bending.

### ANNEALED TEST PIECES.

3. Material which is to be used without annealing or further treatment is to be tested in the condition in which it comes from the rolls. When material is to be annealed or otherwise treated before use, the specimen representing such material is to be similarly treated before testing.

### MARKING.

4. Every finished piece of steel shall be stamped with the melt number. Rivet steel may be shipped in bundles securely wired together, with the melt number on a metal tag attached.

### FINISH.

5. *All plates* shall be free from surface defects and have a workmanlike *finish.*

### CHEMICAL PROPERTIES.

3. The maximum allowable limits of phosphorus and sulphur shall as follows:

| | | | | |
|---|---|---|---|---|
| 2. Flange or Boiler Steel. | Maximum | Phosphorus | .06 | per cent. |
| | " | Sulphur | .04 | " |
| 3. Extra Soft and Fire Box Steel. | " | Phosphorus | .04 | " |
| | " | Sulphur | .04 | " |
| 4. Boiler Rivet Steel. | " | Phosphorus | .04 | " |
| | " | Sulphur | .04 | " |

### PHYSICAL PROPERTIES.

7. Steel shall be of four grades—EXTRA SOFT, FIRE BOX, FLANGE BOILER, and BOILER RIVET STEEL.

### EXTRA SOFT STEEL.

8. Ultimate strength, 45 000 to 55 000 pounds per square inch.
Elastic limit, not less than one-half the ultimate strength.
Elongation, 28 per cent.
Cold and quench bends, 180 degrees flat on itself, without fracture outside of bent portion.

### FIRE BOX STEEL.

9. Ultimate strength, 52 000 to 62 000 pounds per square inch.
Elastic limit, not less than one-half the ultimate strength.
Elongation, 26 per cent.
Cold and quench bends, 180 degrees flat on itself, without fracture on side of bent portion.

### FLANGE OR BOILER STEEL.

10. Ultimate strength, 52 000 to 62 000 pounds per square inch.
Elastic limit, not less than one-half the ultimate strength.
Elongation, 25 per cent.
Cold and quench bends, 180 degrees flat on itself, without fracture on side of bent portion.

### BOILER RIVET STEEL.

11. Steel for boiler rivets shall be made of the extra soft quality specified in paragraph No. 8.

### VARIATION IN WEIGHT.

12. The variation in cross section or weight of more than 2½ per cent. from that specified will be sufficient cause for rejection, except in the case of sheared plates, which will be covered by the following permissible variations:

*a.* Plates 12½ pounds per square foot or heavier, up to 100 inch wide, when ordered to weight, shall not average more than 2½ p cent. variation above, or 2½ per cent. below the theoretical weig When 100 inches wide and over, 5 per cent. above, or 5 per cent. bel the theoretical weight.

Plates under 12½ pounds per square foot, when ordered to weig shall not average a greater variation than the following:

*b.* Up to 75 inches wide, 2½ per cent. above, or 2½ per cent. bel the theoretical weight. 75 inches wide up to 100 inches wide, 5 p cent. above, or 3 per cent. below the theoretical weight. When 1 inches wide and over, 10 per cent. above, or 3 per cent. below t theoretical weight.

*c.* For all plates ordered to gauge, there will be permitted an avera excess of weight over that corresponding to the dimensions on t order equal in amount to that specified in the following table:

## TABLE OF ALLOWANCES FOR OVERWEIGHT FOR RECTANGULAR PLATES WHEN ORDERED TO GAUGE.

Plates will be considered up to gauge if measuring not over 1 inch less than the ordered gauge.

The weight of one cubic inch of rolled steel is assumed to be 0.2 pounds.

PLATE ¼ INCH AND OVER IN THICKNESS.

| THICKNESS OF PLATE. | WIDTH OF PLATE. | | |
|---|---|---|---|
| | Up to 75 Inches. | 75 Inches to 100 Inches. | Over 100 Inches. |
| ¼ inch | 10 per cent. | 14 per cent. | 18 per cent. |
| 5/16 " | 8 " | 12 " | 16 " |
| 3/8 " | 7 " | 10 " | 13 " |
| 7/16 " | 6 " | 8 " | 10 " |
| ½ " | 5 " | 7 " | 9 " |
| 9/16 " | 4½ " | 6½ " | 8½ " |
| 5/8 " | 4 " | 6 " | 8 " |
| Over 5/8 " | 3½ " | 5 " | 6½ " |

PLATE UNDER ¼ INCH IN THICKNESS.

| THICKNESS OF PLATE. Inch. | WIDTH OF PLATE. | |
|---|---|---|
| | Up to 50 Inches. | 50 Inches and Over. |
| ¼ up to 5/32 | 10 per cent. | 15 per cent. |
| 5/32 " 3/16 | 8½ " | 12½ " |
| 3/16 " ¼ | 7 " | 10 " |

## WOODEN BEAMS AND COLUMNS.

The results of a series of very complete studies of wooden beams and columns of various kinds of American timber are contained in the Proceedings of the Fifth Annual Convention of the Association of Railway Superintendents of Bridges and Buildings, October, 1895, at which Mr. Walter Berg, Chairman of the Committee on Strength of Bridge and Trestle Timbers, presented a report, extracts and tables from which are given in the following pages.

The publications of the Forestry Division of the United States Department of Agriculture, Bulletins Nos. 8 and 12, and Circular No. 15, contain reports of recent tests of American woods, and deductions drawn therefrom by Prof. J. B. Johnson, and A. L. Johnson, who conducted the work under the direction of Mr. B. E. Fernow, Chief of the Forestry Division. Extracts and tables from these reports are given on the following pages.

The tables of safe loads for wooden beams and tables of strength of wooden columns given on the following pages have been specially calculated for this book, using as a basis the information regarding the properties of the various species contained in the reports above referred to.

### Explanation of the Tables of Safe Loads in Pounds, Uniformly Distributed for Rectangular Wooden Beams One Inch Thick, Pages 824 to 829, Inclusive.

*General.*

For convenience in use, three of these tables have been prepared each of which applies to woods having practically the same transverse strength or allowable fibre stress per square inch.

The values given in the tables are the safe loads in pounds uniformly distributed exclusive of the weight of the beam itself for rectangular beams one inch thick for spans from four to thirty-five feet and for depths from four to twenty-four inches. The safe load for a beam of any thickness may be found by multiplying the values given in the tables by the thickness of the beam in inches.

The last column of each of the three Tables of Safe Loads for Rectangular Wooden Beams gives a coefficient of deflection by means of which the deflection for any beam may be obtained, corresponding to the given span and safe load, by dividing the coefficient by the depth of the beam in inches, which will give approximately the deflection in *inches under the given* conditions.

In each table the deflection coefficient is given for one species of wood only as shown, but the deflections for other species may be obtained from these by proportion as explained hereafter.

For the reason that wood has no well-defined limit or modulus of elasticity the deflections obtained by the use of the coefficients are only approximate and will vary, dependent upon the moisture content of the wood and the character of the loading. The deflections thus obtained are therefore only useful as a general indication of the amount of bending to be expected under the given conditions and are not exact as in the case of materials like steel, which has a well-defined limit and modulus of elasticity.

The safe loads for other species of woods than those stated in the headings of the tables may be obtained from those given, by direct proportion, dependent upon the ratio of their allowable unit stress as compared with that for which the table is figured, as stated in the footnotes at the bottom of the tables.

## Explanation of the Table of Safe Loads for Rectangular Beams of White Pine, Norway Pine, Spruce and Eastern Fir.

The various species of woods the values for which are included in this table are calculated for an allowable fibre stress of 700 pounds per square inch.

The deflection coefficients are given for white pine, and are based on a modulus of elasticity of 1 000 000 pounds per square inch.

The lower dotted line crossing the table indicates the limits of spans for which the deflection will exceed $\frac{1}{360}$ of the span for the kind of wood for which the deflection coefficient is given. For spans below the line the safe loads given in the tables will produce a deflection greater than $\frac{1}{360}$ of the span, while those above the line will produce less than this, which is the usual limit of deflection in order to prevent cracking of plastered ceilings. Similarly the upper dotted line indicates the limit of deflection for the kind of wood for which the deflection coefficient is given, corresponding to a modulus of elasticity of 500 000 pounds per square inch which should be considered in cases where the deflection should be closely limited to prevent damage to decorative work or plaster on the ceilings. The coefficient of deflection for Norway pine, spruce and Eastern fir for a modulus of elasticity of 1 200 000 pounds per square inch may be obtained by

multiplying those given in the tables for white pine by $\frac{5}{8}$, and for modulus of elasticity of 600 000 by multiplying the same by $\frac{5}{3}$.

The upper full zig-zag line in the table gives the limits of the saf loads corresponding to the allowable shearing stress along the neutra axis of the beam. The safe loads above the line, which are based upo the extreme fibre strains, will produce shearing stresses along the axi or with the grain in excess of that allowable, which in the case c white pine and the other woods of this table is 100 pounds per squar inch.

The position of this line which indicates the limit of safe loads fo shearing along the neutral axis was determined by the aid of the fo lowing formula:

$$W = \frac{4bds}{3}$$

in which

W = safe load in pounds uniformly distributed.

d = depth of beam in inches.

b = breadth of beam in inches.

s = allowable shear in the direction of the grain in pounds pe square inch.

EXPLANATION OF THE TABLE OF SAFE LOADS FOR RECTANGULAI BEAMS OF WHITE OAK AND SHORT-LEAF YELLOW PINE.

The table is calculated for an allowable fibre stress for flexure o 1000 pounds per square inch.

The deflection coefficients are figured for a modulus of elasticity c 1 100 000 pounds per square inch, but may be used for other, obtainin the deflections for other moduli as explained heretofore.

The lower dotted line across the table indicates the limits of span for which the safe load will produce deflections greater than $\frac{1}{360}$ c the length of the beam. Values above the line will give less deflectio than this, and those below will give greater, based on a modulus c 1 100 000 pounds per square inch. Similarly the upper dotted line in dicates the limit of deflection corresponding to a modulus of elastic *of 550 000 pounds per* square inch.

The lower full zig-zag line across the table indicates the limiting spans and loads based on the allowable intensity of shearing stress along the neutral axis of the beam. The values above the lower zig-zag line correspond to shearing stresses greater than the allowable stress in the direction of the grain for short-leaf yellow pine, while those below the line correspond to shearing stresses less than that allowable which in this case is assumed to be 100 pounds per square inch.

Similarly the upper full zig-zag line indicates the limits for shearing along the axis for white oak based on an allowable intensity of 200 pounds per square inch.

### Explanation of Tables of Safe Loads for Rectangular Beams of Long-leaf Yellow Pine.

This table is computed for an allowable fibre stress of 1 200 pounds per square inch and the deflection coefficients are calculated for a modulus of elasticity of 1 700 000 pounds per square inch.

The limit for a deflection of $\frac{1}{360}$ of the span is indicated by the lower dotted zig-zag line on the tables, the values below which correspond to greater and those above to less than the limiting deflection. The upper dotted zig-zag line indicates the limit of deflection for a modulus of elasticity of 850 000 pounds per square inch.

The full zig-zag line indicates the limit of allowable shearing stress along the axis corresponding to an allowable intensity of 150 pounds per square inch.

## BEARING AT POINTS OF SUPPORT.

Care should be taken in designing to provide sufficient bearing at the points of support so that the allowable intensity of compression across the grain as given in the table on pages 321 and 323 is not exceeded.

This may be obtained where necessary by the use of corbels or *bearing plates of* harder wood so arranged as to give a large bearing *area against the* softer beam.

The following statements are made in Bulletin No. 12, U. S. Department of Agriculture, Division of Forestry:

## RECOMMENDED PRACTICE.

"Since the strength of timber varies very greatly with the moisture contents (see Bulletin 8 of the Forestry Division), the economical designing of such structures will necessitate their being separated into groups according to the maximum moisture contents in use.

## MOISTURE CLASSIFICATION.

"Class A (moisture contents, 18 per cent.)—Structures freely exposed to the weather, such as railway trestles, uncovered bridges, etc.

"Class B (moisture contents, 15 per cent.)—Structures under roof but without side shelter, freely exposed to outside air, but protected from rain, such as roof trusses of open shops and sheds, covered bridges over streams, etc.

"Class C (moisture contents, 12 per cent.)—Structures in buildings unheated, but more or less protected from outside air, such as roof trusses or barns, enclosed shops and sheds, etc.

"Class D (moisture contents, 10 per cent.)—Structures in buildings at all times protected from the outside air, heated in the winter, such as roof trusses in houses, halls, churches, etc.

"For long-leaf pine add to all the values given in the tables, except those for moduli of elasticity, tension and shearing, for Class B, 15 per cent.; for Class C, 40 per cent.; and for Class D, 55 per cent. For the other species add to these values, for Class B, 8 per cent.; for Class C, 18 per cent., and for Class D, 25 per cent."

Based upon the above classification of structures, the two following tables have been figured to facilitate calculations of allowable loads for wooden columns and beams.

### PROPORTION OF THE VALUES GIVEN IN THE "TABLES OF SAFE LOADS FOR WOODEN BEAMS," PAGES 324 TO 329 INCLUSIVE, TO BE USED IN ORDER TO OBTAIN THE SAFE LOADS FOR THE VARIOUS CLASSES OF STRUCTURES REFERRED TO ABOVE.

| Classes. | Yellow Pine. | All Others. |
|---|---|---|
| Class A | 1.00 | 1.00 |
| Class B | 1.15 | 1.08 |
| Class C | 1.40 | 1.18 |
| *Class D* | 1.55 | 1.25 |

## SAFETY FACTORS TO BE APPLIED TO THE VALUES GIVEN IN THE TABLE OF "STRENGTH OF SOLID WOODEN COLUMNS," PAGES 330 AND 331, IN ORDER TO OBTAIN THE SAFE LOADS FOR THE VARIOUS CLASSES OF STRUCTURES REFERRED TO ABOVE.

| Classes. | Yellow Pine. | All Others. |
|---|---|---|
| Class A | 0.20 | 0.20 |
| Class B | 0.23 | 0.22 |
| Class C | 0.28 | 0.24 |
| Class D | 0.31 | 0.25 |

## SPECIFIC GRAVITY AND WEIGHT PER FOOT FOR VARIOUS KINDS OF TIMBER.

| Name of Wood. | Specific Gravity. | Weight per Cubic Foot. | Weight per Foot Board Measure. |
|---|---|---|---|
| White Oak | 0.80 | 49.94 | 4.16 |
| White Pine | 0.38 | 23.72 | 1.98 |
| Southern Long-leaf or Georgia Yellow Pine | 0.51 | 31.84 | 2.65 |
| Douglas, Oregon and Washington Fir or Pine, { Yellow Fir. | 0.51 | 31.84 | 2.65 |
| Douglas, Oregon and Washington Fir or Pine, { Red Fir. | 0.46 | 28.84 | 2.40 |
| Northern or Short-leaf Yellow Pine | 0.61 | 38.08 | 3.17 |
| Red Pine | 0.50 | 31.21 | 2.60 |
| Norway Pine | 0.50 | 31.21 | 2.60 |
| Canadian (Ottawa) White Pine | 0.60 | 37.46 | 3.15 |
| " (Ontario) Red " | 0.55 | 34.34 | 2.88 |
| Spruce and Eastern Fir | 0.40 | 24.97 | 2.08 |
| Hemlock | 0.40 | 24.97 | 2.08 |
| Cypress | 0.46 | 28.72 | 2.39 |
| Cedar | 0.37 | 23.10 | 1.93 |
| Chestnut | 0.66 | 41.20 | 3.43 |
| California Redwood | 0.39 | 24.16 | 2.01 |
| California Spruce | 0.40 | 24.97 | 2.08 |

The specific gravities and weights given above are the averages of a large number of determinations by various authorities, for woods containing less than 15 per cent. of moisture or such as are commercially known as dry timber. The weights of green or unseasoned woods *will be from* 20 to 40 per cent. greater than those given in the above *table.*

## SAFE UNIT STRESSES FOR TIMBER.

ECOMMENDED IN BULLETIN No. 12, U. S. DEPARTMENT OF AGRICULTURE.

**Division of Forestry.**

Safe Unit Stresses at 18% Moisture.

| Species. | Modulus of Strength at Rupture per Square Inch. | Modulus of Elasticity per Square Inch. | Elastic Resilience per Cubic Inch. | Crushing Strength End-wise per Square Inch. | Crushing Strength Across the Grain per Square Inch. | Tensile Strength per Square Inch. | Shearing Strength per Square Inch. |
|---|---|---|---|---|---|---|---|
| | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. | Lbs. |
| g-leaf Pine (Pinus ılustris) D | 1550 | 720000 | 1.30 | 1000 | 215 | 12000 | 125 |
| t-leaf Pine (Pinus hinata) D | 1300 | 600000 | 1.30 | 840 | 215 | 9000 | 100 |
| te Pine (Pinus stro-ıs) | 880 | 435000 | 1.00 | 700 | 147 | 7000 | 75 |
| way Pine (Pinus res-osa) | 1090 | 566000 | .... | 760 | 143 | .... | ... |
| ırado Pine (Pinus ınderosa) | 980 | 444000 | .... | 630 | 180 | .... | ... |
| glas Fir (Pseudot-ga douglasii) | 1320 | 690000 | .... | 880 | 167 | .... | ... |
| wood (Sequoia sem-rvirens) | 1440 | 226000 | .... | 650 | 115 | .... | ... |
| Cedar (Juniperus rginiana) | 1000 | 335000 | .... | 700 | 250 | .... | ... |
| Cypress (Taxodium stichum) D | 1000 | 450000 | 1.10 | 675 | 120 | 6000 | 60 |
| te Oak (Quercus ba) D | 1200 | 550000 | 1.25 | 800 | 400 | 10000 | 200 |
| or of Safety | 5 | 2 | 1 | 5 | 3 | 1 | 4 |

ıe values marked "D" were obtained from experiments made by Forestry Division. The other values were obtained from various ıes, chiefly the 10th Census Report, but so modified as to give ts comparable with Forestry Division values. To arrive at true ıge values of strength multiply safe loads by factor of safety given ch column. The values for resilience and tensile strength are the ıate values. The former is practically never used in designing. latter is a factor impossible to develop in practice, since the piece always fail in some other way, usually by shearing.

ıe crushing *strength* across the grain in above is based upon a *ing of 8 per cent. of* the cross sectional height of the piece.

## AVERAGE ULTIMATE BREAKING UNIT

Recommended by the Committee on
Association of Railway Superin
Fifth Annual Convention,

| Kind of Timber. | Tension. | |
|---|---|---|
| | With Grain. | Across Grain. |
| White Oak | 10000 | 2000 |
| White Pine | 7000 | 500 |
| Southern Long-leaf or Georgia Yellow Pine | 12000 | 600 |
| Douglas, Oregon and Yellow Fir | 12000 | .... |
| Washington Fir or Pine (Red Fir) | 10000 | .... |
| Northern or Short-leaf Yellow Pine | 9000 | 500 |
| Red Pine | 9000 | 500 |
| Norway Pine | 8000 | .... |
| Canadian (Ottawa) White Pine | 10000 | .... |
| Canadian (Ontario) Red Pine | 10000 | .... |
| Spruce and Eastern Fir | 8000 | 500 |
| Hemlock | 6000 | .... |
| Cypress | 6000 | .... |
| Cedar | 8000 | .... |
| Chestnut | 9000 | .... |
| California Redwood | 7000 | .... |
| California Spruce | .... | .... |

## AVERAGE SAFE ALLOWABLE WORKING UNIT

Recommended by the Committee on
Association of Railway Superin
Fifth Annual Convention,

| Kind of Timber. | Tension. | |
|---|---|---|
| | With Grain. | Across Grain. |
| Factor of Safety. | Ten. | Ten. |
| White Oak | 1000 | 200 |
| White Pine | 700 | 50 |
| Southern Long-leaf or Georgia Yellow Pine | 1200 | 60 |
| Douglas, Oregon and Yellow Fir | 1200 | .... |
| Washington Fir or Pine (Red Fir) | 1000 | .... |
| Northern or Short-leaf Yellow Pine | 900 | 50 |
| Red Pine | 900 | 50 |
| Norway Pine | 800 | .... |
| Canadian (Ottawa) White Pine | 1000 | .... |
| Canadian (Ontario) Red Pine | 1000 | .... |
| Spruce and Eastern Fir | 800 | 50 |
| Hemlock | 600 | .... |
| Cypress | 600 | .... |
| Cedar | 800 | .... |
| *Chestnut* | 900 | .... |
| *California Redwood* | 700 | .... |
| *California Spruce* | .... | .... |

## ESSES, IN POUNDS, PER SQUARE INCH.

gth of Bridge and Trestle Timbers."
s of Bridges and Buildings.
leans, October, 1895.

| Compression. | | | Transverse. | | Shearing. | |
|---|---|---|---|---|---|---|
| With Grain. | | | | | | |
| ring. | Columns Under 15 Diams. | Across Grain. | Extreme Fibre Stress. | Modulus of Elasticity. | With Grain. | Across Grain. |
| 00 | 4500 | 2000 | 6000 | 1100000 | 800 | 4000 |
| 00 | 3500 | 800 | 4000 | 1000000 | 400 | 2000 |
| 00 | 5000 | 1400 | 7000 | 1700000 | 600 | 5000 |
| 00 | 6000 | 1200 | 6500 | 1400000 | 600 | .... |
| | | | 5000 | | | |
| 00 | 4000 | 1000 | 6000 | 1200000 | 400 | 4000 |
| 00 | 4000 | 800 | 5000 | 1200000 | .... | .... |
| 00 | 4000 | 800 | 4000 | 1200000 | .... | .... |
| . | 5000 | .... | .... | ..... | 350 | .... |
| . | 5000 | .... | 5000 | 1400000 | 400 | .... |
| 00 | 4000 | 700 | 4000 | 1200000 | 400 | 3000 |
| . | 4000 | 600 | 3500 | 900000 | 350 | 2500 |
| 00 | 4000 | 700 | 5000 | 900000 | .... | .... |
| 00 | 4000 | 700 | 5000 | 700000 | .... | 1500 |
| . | 5000 | 900 | 5000 | 1000000 | 600 | 1500 |
| . | 4000 | 800 | 4500 | 700000 | 400 | .... |
| . | 4000 | .... | 5000 | 1200000 | .... | .... |

## ESSES, IN POUNDS, PER SQUARE INCH.

gth of Bridge and Trestle Timbers."
s of Bridges and Buildings.
leans, October, 1895.

| Compression. | | | Transverse. | | Shearing. | |
|---|---|---|---|---|---|---|
| With Grain. | | | | | | |
| ring. | Columns Under 15 Diams. | Across Grain. | Extreme Fibre Stress. | Modulus of Elasticity. | With Grain. | Across Grain. |
| | Five. | Four. | Six. | Two. | Four. | Four. |
| 00 | 900 | 500 | 1000 | 550000 | 200 | 1000 |
| 00 | 700 | 200 | 700 | 500000 | 100 | 500 |
| 00 | 1000 | 350 | 1200 | 850000 | 150 | 1250 |
| 00 | 1200 | 300 | 1100 | 700000 | 150 | .... |
| | | | 800 | | | |
| 00 | 800 | 250 | 1000 | 600000 | 100 | 1000 |
| 00 | 800 | 200 | 800 | 600000 | .... | .... |
| 00 | 800 | 200 | 700 | 600000 | .... | .... |
| . | 1000 | .... | .... | .... | 100 | .... |
| . | 1000 | .... | 800 | 700000 | 100 | .... |
| 00 | 800 | 200 | 700 | 600000 | 100 | 750 |
| | 800 | 150 | 600 | 450000 | 100 | 600 |
| 00 | 800 | 200 | 800 | 450000 | .... | .... |
| 00 | 800 | 200 | 800 | 350000 | .... | 400 |
| . | 1000 | 250 | 800 | 500000 | 150 | 400 |
| . | 800 | 200 | 750 | 350000 | 100 | .... |
| | 800 | .... | 800 | 600000 | .... | .... |

# SAFE LOAD IN POUNDS FOR RECTANGULAR OF WHITE PINE, NORWAY PINE

Allowable fibre stress 700 pounds per square inch safety factor 6.

Safe loads for other factors of safety may be obtained as follows:

| Span in Feet. | Depth of Beam in Inches. | | | | | | | | | | | Deflection Coefficient for White Pine. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | V |
| 4 | 311 | 486 | 700 | 953 | 1244 | 1575 | 1944 | 2352 | 2800 | 3286 | 3811 | .34 |
| 5 | 249 | 389 | 560 | 762 | 996 | 1260 | 1556 | 1882 | 2240 | 2629 | 3049 | .53 |
| 6 | 207 | 324 | 467 | 635 | 830 | 1050 | 1296 | 1569 | 1867 | 2191 | 2541 | .76 |
| 7 | 178 | 278 | 400 | 544 | 711 | 900 | 1111 | 1344 | 1600 | 1878 | 2178 | 1.03 |
| 8 | 156 | 243 | 350 | 476 | 622 | 788 | 972 | 1176 | 1400 | 1643 | 1906 | 1.34 |
| 9 | 138 | 216 | 311 | 423 | 553 | 700 | 864 | 1046 | 1244 | 1460 | 1694 | 1.70 |
| 10 | 124 | 194 | 280 | 381 | 498 | 630 | 778 | 941 | 1120 | 1314 | 1524 | 2.10 |
| 11 | 113 | 177 | 255 | 346 | 453 | 573 | 707 | 856 | 1018 | 1195 | 1386 | 2.54 |
| 12 | 103 | 162 | 233 | 318 | 415 | 525 | 648 | 784 | 933 | 1095 | 1270 | 3.02 |
| 13 | 96 | 150 | 215 | 293 | 383 | 485 | 598 | 724 | 862 | 1011 | 1173 | 3.55 |
| 14 | 89 | 139 | 200 | 272 | 356 | 450 | 556 | 672 | 800 | 939 | 1089 | 4.12 |
| 15 | 83 | 130 | 187 | 254 | 332 | 420 | 519 | 627 | 747 | 876 | 1016 | 4.73 |
| 16 | 78 | 122 | 175 | 238 | 311 | 394 | 486 | 588 | 700 | 821 | 953 | 5.38 |
| 17 | 73 | 114 | 165 | 224 | 293 | 371 | 458 | 554 | 659 | 773 | 897 | 6.07 |
| 18 | 69 | 108 | 156 | 212 | 277 | 350 | 432 | 523 | 622 | 730 | 847 | 6.80 |
| 19 | 65 | 102 | 147 | 201 | 262 | 332 | 409 | 495 | 589 | 692 | 802 | 7.58 |
| 20 | | 97 | 140 | 191 | 249 | 315 | 389 | 471 | 560 | 657 | 762 | 8.40 |
| 21 | | 93 | 133 | 182 | 237 | 300 | 370 | 448 | 533 | 626 | 726 | 9.26 |
| 22 | | 88 | 127 | 173 | 226 | 286 | 354 | 428 | 509 | 597 | 693 | 10.16 |
| 23 | | 85 | 122 | 166 | 216 | 274 | 338 | 409 | 487 | 572 | 663 | 11.11 |
| 24 | | | 117 | 159 | 207 | 263 | 324 | 392 | 467 | 548 | 635 | 12.10 |
| 25 | | | 112 | 152 | 199 | 252 | 311 | 376 | 448 | 526 | 610 | 13.13 |
| 26 | | | 108 | 147 | 191 | 242 | 299 | 362 | 431 | 506 | 586 | 14.20 |
| 27 | | | 104 | 141 | 184 | 233 | 288 | 349 | 415 | 487 | 565 | 15.31 |
| 28 | | | 100 | 136 | 178 | 225 | 278 | 336 | 400 | 469 | 544 | 16.46 |
| 29 | | | 97 | 131 | 172 | 217 | 268 | 325 | 386 | 453 | 526 | 17.66 |
| 30 | | | 93 | 127 | 166 | 210 | 259 | 314 | 373 | 438 | 508 | 18.90 |
| 31 | | | 90 | 123 | 161 | 203 | 251 | 304 | 361 | 424 | 492 | 20.18 |
| 32 | | | 88 | 119 | 156 | 197 | 243 | 294 | 350 | 411 | 476 | 21.50 |
| 33 | | | 85 | 115 | 151 | 191 | 236 | 285 | 339 | 398 | 462 | 22.87 |
| 34 | | | | 112 | 146 | 185 | 229 | 277 | 329 | 387 | 448 | 24.28 |
| | | | | 109 | 142 | 180 | 222 | 269 | 320 | 376 | 436 | 25.73 |

# UNIFORMLY DISTRIBUTED BEAMS ONE INCH THICK AND SPRUCE OR EASTERN FIR.

**Modulus of rupture 4 200 pounds per square inch.**

**New safe load = Safe load from table $\times \frac{6}{\text{New factor}}$.**

| Span in Feet. | Depth of Beam in Inches. | | | | | | | | | | Deflection Coefficient for White Pine. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | V |
| 9 | 1944 | 2212 | 2498 | 2800 | 3120 | 3457 | 3811 | 4183 | 4571 | 4978 | 1.70 |
| 10 | 1750 | 1991 | 2248 | 2520 | 2808 | 3111 | 3430 | 3764 | 4114 | 4480 | 2.10 |
| 11 | 1601 | 1810 | 2044 | 2291 | 2552 | 2828 | 3118 | 3422 | 3740 | 4073 | 2.54 |
| 12 | 1458 | 1659 | 1873 | 2100 | 2340 | 2593 | 2858 | 3137 | 3428 | 3733 | 3.02 |
| 13 | 1346 | 1531 | 1729 | 1938 | 2160 | 2393 | 2638 | 2896 | 3165 | 3446 | 3.55 |
| 14 | 1250 | 1422 | 1606 | 1800 | 2056 | 2222 | 2450 | 2689 | 2939 | 3200 | 4.12 |
| 15 | 1167 | 1328 | 1499 | 1680 | 1872 | 2074 | 2287 | 2510 | 2743 | 2987 | 4.73 |
| 16 | 1094 | 1244 | 1405 | 1575 | 1755 | 1944 | 2144 | 2353 | 2571 | 2800 | 5.38 |
| 17 | 1029 | 1171 | 1322 | 1482 | 1652 | 1830 | 2018 | 2214 | 2420 | 2635 | 6.07 |
| 18 | 972 | 1106 | 1249 | 1400 | 1560 | 1728 | 1906 | 2091 | 2286 | 2489 | 6.80 |
| 19 | 921 | 1048 | 1183 | 1326 | 1478 | 1637 | 1805 | 1981 | 2165 | 2358 | 7.58 |
| 20 | 875 | 996 | 1124 | 1260 | 1404 | 1556 | 1715 | 1882 | 2057 | 2240 | 8.40 |
| 21 | 833 | 948 | 1070 | 1200 | 1337 | 1481 | 1633 | 1793 | 1959 | 2133 | 9.26 |
| 22 | 795 | 905 | 1022 | 1145 | 1276 | 1414 | 1559 | 1711 | 1870 | 2036 | 10.16 |
| 23 | 761 | 866 | 977 | 1096 | 1221 | 1353 | 1491 | 1637 | 1789 | 1948 | 11.11 |
| 24 | 729 | 830 | 937 | 1050 | 1170 | 1296 | 1429 | 1569 | 1714 | 1867 | 12.10 |
| 25 | 700 | 796 | 899 | 1008 | 1123 | 1244 | 1372 | 1506 | 1645 | 1792 | 13.13 |
| 26 | 673 | 766 | 865 | 969 | 1080 | 1197 | 1319 | 1448 | 1582 | 1723 | 14.20 |
| 27 | 648 | 737 | 833 | 933 | 1040 | 1152 | 1270 | 1394 | 1524 | 1659 | 15.31 |
| 28 | 625 | 711 | 803 | 900 | 1003 | 1111 | 1225 | 1344 | 1469 | 1600 | 16.46 |
| 29 | 603 | 687 | 775 | 869 | 968 | 1073 | 1183 | 1298 | 1419 | 1545 | 17.66 |
| 30 | 583 | 664 | 749 | 840 | 936 | 1037 | 1143 | 1255 | 1371 | 1493 | 18.90 |
| 31 | 565 | 642 | 725 | 813 | 906 | 1004 | 1106 | 1214 | 1327 | 1445 | 20.18 |
| 32 | 547 | 622 | 703 | 787 | 877 | 972 | 1072 | 1176 | 1286 | 1400 | 21.50 |
| 33 | 534 | 603 | 681 | 764 | 850 | 943 | 1039 | 1141 | 1247 | 1358 | 22.87 |
| 34 | 515 | 586 | 661 | 741 | 826 | 915 | 1009 | 1107 | 1210 | 1318 | 24.28 |
| 35 | 500 | 569 | 642 | 720 | 802 | 889 | 980 | 1076 | 1176 | 1280 | 25.73 |
| 36 | 486 | 553 | 624 | 700 | 780 | 864 | 953 | 1046 | 1143 | 1244 | 27.22 |
| 37 | 473 | 538 | 608 | 681 | 759 | 841 | 927 | 1017 | 1112 | 1211 | 28.75 |
| 38 | 460 | 524 | 592 | 663 | 739 | 819 | 903 | 991 | 1083 | 1179 | 30.32 |
| 39 | 449 | 511 | 576 | 646 | 720 | 798 | 880 | 965 | 1055 | 1149 | 31.94 |
| 40 | 438 | 498 | 562 | 630 | 702 | 778 | 858 | 941 | 1029 | 1120 | 33. |

## SAFE LOAD IN POU
## FOR RECTANGU
## WHITE OAK

Allowable fibre stress 1 000 pounds per square inch safety f

Safe loads for other factors of safety may be obtained as f

| Span in Feet. | Depth of Beam in Inches. | | | | | | | | | | | De Coef Wh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| 4 | 444 | 694 | 1000 | 1361 | 1778 | 2250 | 2778 | 3361 | 4000 | 4694 | 5444 | |
| 5 | 356 | 556 | 800 | 1089 | 1422 | 1800 | 2222 | 2689 | 3200 | 3756 | 4356 | |
| 6 | 296 | 463 | 667 | 907 | 1185 | 1500 | 1852 | 2241 | 2667 | 3130 | 3630 | |
| 7 | 254 | 397 | 571 | 778 | 1016 | 1286 | 1587 | 1921 | 2286 | 2683 | 3111 | |
| 8 | 222 | 347 | 500 | 681 | 889 | 1125 | 1389 | 1681 | 2000 | 2347 | 2722 | |
| 9 | 198 | 309 | 444 | 605 | 790 | 1000 | 1235 | 1494 | 1778 | 2086 | 2420 | |
| 10 | 178 | 278 | 400 | 544 | 711 | 900 | 1111 | 1344 | 1600 | 1878 | 2178 | |
| 11 | 162 | 253 | 364 | 495 | 646 | 818 | 1010 | 1222 | 1455 | 1707 | 1980 | |
| 12 | 148 | 231 | 333 | 454 | 593 | 750 | 926 | 1120 | 1333 | 1565 | 1815 | |
| 13 | 137 | 214 | 308 | 419 | 547 | 692 | 855 | 1034 | 1231 | 1444 | 1675 | |
| 14 | 127 | 198 | 286 | 389 | 508 | 643 | 794 | 960 | 1143 | 1341 | 1556 | |
| 15 | 119 | 185 | 267 | 363 | 474 | 600 | 741 | 896 | 1067 | 1252 | 1452 | |
| 16 | 111 | 174 | 250 | 340 | 444 | 563 | 694 | 840 | 1000 | 1174 | 1361 | |
| 17 | 105 | 163 | 235 | 320 | 418 | 529 | 654 | 791 | 941 | 1105 | 1281 | |
| 18 | 99 | 154 | 222 | 302 | 395 | 500 | 617 | 747 | 889 | 1043 | 1210 | |
| 19 | 94 | 146 | 211 | 287 | 374 | 474 | 585 | 708 | 842 | 988 | 1146 | |
| 20 | 89 | 139 | 200 | 272 | 356 | 450 | 556 | 672 | 800 | 939 | 1089 | |
| 21 | 85 | 132 | 190 | 259 | 339 | 429 | 529 | 640 | 762 | 894 | 1037 | |
| 22 | 81 | 126 | 182 | 247 | 323 | 409 | 505 | 611 | 727 | 854 | 990 | |
| 23 | 77 | 121 | 174 | 237 | 309 | 391 | 483 | 585 | 696 | 816 | 947 | 1 |
| 24 | | 116 | 162 | 227 | 296 | 375 | 463 | 560 | 667 | 782 | 907 | 1 |
| 25 | | 111 | 160 | 218 | 284 | 360 | 444 | 538 | 640 | 751 | 871 | 1 |
| 26 | | 107 | 154 | 209 | 274 | 346 | 427 | 517 | 615 | 722 | 838 | 1 |
| 27 | | 103 | 148 | 202 | 263 | 333 | 412 | 498 | 593 | 695 | 807 | 1 |
| 28 | | 99 | 143 | 194 | 254 | 321 | 397 | 480 | 571 | 671 | 778 | 1 |
| 29 | | | 138 | 188 | 245 | 310 | 383 | 464 | 552 | 648 | 751 | 1 |
| 30 | | | 133 | 181 | 237 | 300 | 370 | 448 | 533 | 626 | 726 | 1 |
| 31 | | | 129 | 176 | 229 | 290 | 358 | 434 | 516 | 606 | 703 | 1 |
| 32 | | | 125 | 170 | 222 | 281 | 347 | 420 | 500 | 587 | 681 | 1 |
| 33 | | | 121 | 165 | 215 | 273 | 337 | 407 | 485 | 569 | 660 | 2 |
| 34 | | | 118 | 160 | 209 | 265 | 327 | 395 | 471 | 552 | 641 | 2 |
| 35 | | | 114 | 156 | 203 | 257 | 317 | 384 | 457 | 537 | 602 | 2 |

*Safe load* for beams of Douglas and Oregon Fir or Pine ¼ of above.

# NIFORMLY DISTRIBUTED EAMS ONE INCH THICK HORT-LEAF YELLOW PINE.

odulus of rupture 6 000 pounds per square inch.

ew safe load = Safe load from table $\times \frac{6}{\text{New factor}}$.

| pan in eet. | Depth of Beam in Inches. | | | | | | | | | | Deflection Coefficient for White Oak. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | v |
| 9 | 2778 | 3160 | 3568 | 4000 | 4457 | 4938 | 5444 | 5975 | 6531 | 7111 | 1.55 |
| 10 | 2500 | 2844 | 3211 | 3600 | 4011 | 4444 | 4900 | 5378 | 5878 | 6400 | 1.91 |
| 11 | 2273 | 2586 | 2919 | 3273 | 3646 | 4040 | 4455 | 4889 | 5343 | 5818 | 2.31 |
| 12 | 2083 | 2370 | 2676 | 3000 | 3343 | 3704 | 4083 | 4481 | 4898 | 5333 | 2.75 |
| 13 | 1923 | 2188 | 2470 | 2769 | 3085 | 3419 | 3769 | 4137 | 4521 | 4923 | 3.23 |
| 14 | 1786 | 2032 | 2294 | 2571 | 2865 | 3175 | 3500 | 3841 | 4198 | 4571 | 3.74 |
| 15 | 1667 | 1896 | 2141 | 2400 | 2674 | 2963 | 3267 | 3585 | 3919 | 4267 | 4.30 |
| 16 | 1563 | 1778 | 2007 | 2250 | 2507 | 2778 | 3062 | 3361 | 3674 | 4000 | 4.89 |
| 17 | 1471 | 1673 | 1889 | 2118 | 2359 | 2614 | 2882 | 3163 | 3458 | 3765 | 5.52 |
| 18 | 1389 | 1580 | 1789 | 2000 | 2228 | 2469 | 2722 | 2988 | 3265 | 3556 | 6.19 |
| 19 | 1316 | 1497 | 1690 | 1895 | 2111 | 2339 | 2579 | 2830 | 3094 | 3368 | 6.89 |
| 20 | 1250 | 1422 | 1606 | 1800 | 2006 | 2222 | 2450 | 2689 | 2939 | 3200 | 7.64 |
| 21 | 1190 | 1354 | 1529 | 1714 | 1910 | 2116 | 2333 | 2561 | 2799 | 3048 | 8.42 |
| 22 | 1136 | 1293 | 1460 | 1636 | 1823 | 2020 | 2227 | 2444 | 2672 | 2909 | 9.24 |
| 23 | 1087 | 1237 | 1396 | 1565 | 1744 | 1932 | 2130 | 2338 | 2556 | 2783 | 10.10 |
| 24 | 1042 | 1185 | 1338 | 1500 | 1671 | 1852 | 2042 | 2241 | 2449 | 2667 | 11.00 |
| 25 | 1000 | 1138 | 1284 | 1440 | 1604 | 1778 | 1960 | 2131 | 2351 | 2560 | 11.93 |
| 26 | 962 | 1094 | 1235 | 1385 | 1543 | 1709 | 1885 | 2068 | 2261 | 2462 | 12.91 |
| 27 | 926 | 1053 | 1189 | 1333 | 1486 | 1646 | 1815 | 1992 | 2177 | 2370 | 13.92 |
| 28 | 893 | 1016 | 1147 | 1286 | 1433 | 1587 | 1750 | 1921 | 2099 | 2286 | 14.97 |
| 29 | 862 | 981 | 1107 | 1241 | 1383 | 1533 | 1690 | 1854 | 2027 | 2207 | 16.06 |
| 30 | 833 | 948 | 1070 | 1200 | 1337 | 1481 | 1633 | 1793 | 1959 | 2133 | 17.18 |
| 31 | 806 | 918 | 1036 | 1161 | 1294 | 1434 | 1581 | 1735 | 1896 | 2065 | 18.35 |
| 32 | 781 | 889 | 1003 | 1125 | 1253 | 1389 | 1531 | 1681 | 1837 | 2000 | 19.55 |
| 33 | 758 | 862 | 973 | 1091 | 1215 | 1347 | 1485 | 1630 | 1781 | 1939 | 20.79 |
| 34 | 735 | 837 | 944 | 1059 | 1180 | 1307 | 1441 | 1582 | 1728 | 1882 | 22.07 |
| 35 | 714 | 813 | 917 | 1029 | 1146 | 1270 | 1400 | 1537 | 1677 | 1829 | 23.39 |
| 36 | 694 | 780 | 894 | 1000 | 1114 | 1235 | 1361 | 1494 | 1633 | 1778 | 24.74 |
| 37 | 676 | 769 | 868 | 973 | 1084 | 1201 | 1324 | 1453 | 1589 | 1730 | 26.14 |
| 38 | 658 | 749 | 845 | 947 | 1056 | 1169 | 1289 | 1415 | 1547 | 1684 | 27.57 |
| 39 | 641 | 729 | 823 | 923 | 1028 | 1140 | 1256 | 1379 | 1507 | 1641 | 29.04 |
| 40 | 625 | 711 | 803 | 900 | 1003 | 1111 | 1225 | 1344 | 1469 | 1600 | 30.55 |

*Safe load for* beams of California Redwood ¾ of above.

## SAFE LOAD IN POUNDS FOR RECTANGULAR LONG LEAF

Allowable fibre stress 1 200 pounds per square inch safety factor 6.

Safe loads for other factors of safety may be obtained as follows:

| Span in Feet. | Depth of Beam in Inches. | | | | | | | | | | | Deflection Coefficient. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | v |
| 4 | 533 | 833 | 1200 | 1633 | 2133 | 2700 | 3333 | 4033 | 4800 | 5633 | 6533 | .20 |
| 5 | 427 | 667 | 960 | 1307 | 1707 | 2160 | 2667 | 3227 | 3840 | 4507 | 5227 | .31 |
| 6 | 356 | 556 | 800 | 1089 | 1422 | 1800 | 2222 | 2689 | 3200 | 3756 | 4356 | .44 |
| 7 | 305 | 476 | 686 | 933 | 1219 | 1543 | 1905 | 2305 | 2743 | 3219 | 3733 | .61 |
| 8 | 267 | 417 | 600 | 817 | 1067 | 1350 | 1667 | 2017 | 2400 | 2817 | 3267 | .79 |
| 9 | 237 | 370 | 533 | 726 | 948 | 1200 | 1481 | 1793 | 2133 | 2504 | 2904 | 1.00 |
| 10 | 213 | 333 | 480 | 653 | 853 | 1080 | 1333 | 1613 | 1920 | 2253 | 2613 | 1.24 |
| 11 | 194 | 303 | 436 | 594 | 776 | 982 | 1212 | 1467 | 1745 | 2048 | 2376 | 1.49 |
| 12 | 178 | 278 | 400 | 544 | 711 | 900 | 1111 | 1344 | 1600 | 1878 | 2178 | 1.78 |
| 13 | 164 | 256 | 369 | 503 | 656 | 831 | 1026 | 1241 | 1477 | 1733 | 2010 | 2.09 |
| 14 | 152 | 238 | 343 | 467 | 610 | 771 | 952 | 1152 | 1371 | 1610 | 1867 | 2.42 |
| 15 | 142 | 222 | 320 | 436 | 569 | 720 | 889 | 1076 | 1280 | 1502 | 1742 | 2.78 |
| 16 | 133 | 208 | 300 | 408 | 533 | 675 | 833 | 1008 | 1200 | 1408 | 1633 | 3.16 |
| 17 | 125 | 196 | 282 | 384 | 502 | 635 | 784 | 949 | 1129 | 1325 | 1537 | 3.57 |
| 18 | 119 | 185 | 267 | 363 | 474 | 600 | 741 | 896 | 1067 | 1252 | 1452 | 4.00 |
| 19 | 112 | 175 | 253 | 344 | 449 | 568 | 702 | 849 | 1011 | 1186 | 1375 | 4.46 |
| 20 | 107 | 167 | 240 | 327 | 427 | 540 | 667 | 807 | 960 | 1127 | 1307 | 4.94 |
| 21 | 102 | 159 | 229 | 311 | 406 | 514 | 635 | 768 | 914 | 1073 | 1244 | 5.45 |
| 22 | 97 | 157 | 218 | 297 | 388 | 491 | 606 | 733 | 873 | 1024 | 1188 | 5.98 |
| 23 | 93 | 145 | 209 | 284 | 371 | 470 | 580 | 701 | 835 | 980 | 1136 | 6.53 |
| 24 | 89 | 139 | 200 | 272 | 356 | 450 | 556 | 672 | 800 | 939 | 1089 | 7.12 |
| 25 | 85 | 133 | 192 | 261 | 341 | 432 | 533 | 645 | 768 | 901 | 1045 | 7.72 |
| 26 | | 128 | 185 | 251 | 328 | 415 | 513 | 621 | 738 | 867 | 1005 | 8.35 |
| 27 | | 123 | 178 | 242 | 316 | 400 | 494 | 598 | 711 | 835 | 968 | 9.01 |
| 28 | | 119 | 171 | 233 | 305 | 386 | 476 | 576 | 686 | 805 | 933 | 9.68 |
| 29 | | 115 | 166 | 225 | 294 | 372 | 460 | 556 | 662 | 777 | 901 | 10.39 |
| 30 | | 111 | 160 | 218 | 284 | 360 | 444 | 538 | 640 | 751 | 871 | 11.12 |
| 31 | | 108 | 155 | 211 | 275 | 348 | 430 | 520 | 619 | 727 | 843 | 11.87 |
| 32 | | | 150 | 204 | 267 | 338 | 417 | 504 | 600 | 704 | 817 | 12.65 |
| 33 | | | 145 | 198 | 259 | 327 | 404 | 489 | 582 | 683 | 792 | 13.45 |
| 34 | | | 141 | 192 | 251 | 318 | 392 | 475 | 565 | 663 | 769 | 14.28 |
| 35 | | | 137 | 187 | 244 | 309 | 381 | 461 | 549 | 644 | 747 | 15.13 |

*Safe load* for beams of Washington Fir or Pine, Red Pine, Canadian (Ontario) *Red Pine*, Cypress, Cedar, Chestnut and California Spruce, ⅔ of above.

## ILY DISTRIBUTED
## ONE INCH THICK
## PINE.

ture 7 200 pounds per square inch.

= Safe load from table $\times \frac{6}{\text{New factor}}$

| Depth of Beam in Inches. | | | | | | | | Deflection Coefficient. |
|---|---|---|---|---|---|---|---|---|
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | V |
| 4281 | 4800 | 5348 | 5926 | 6533 | 7170 | 7837 | 8533 | 1.00 |
| 3853 | 4320 | 4813 | 5333 | 5880 | 6453 | 7053 | 7680 | 1.24 |
| 3503 | 3927 | 4376 | 4848 | 5355 | 5867 | 6412 | 6982 | 1.49 |
| 3211 | 3600 | 4011 | 4444 | 4900 | 5378 | 5878 | 6400 | 1.78 |
| 2964 | 3323 | 3703 | 4103 | 4523 | 4964 | 5426 | 5908 | 2.09 |
| 2752 | 3086 | 3438 | 3810 | 4200 | 4610 | 5038 | 5486 | 2.42 |
| 2569 | 2880 | 3209 | 3556 | 3920 | 4302 | 4702 | 5120 | 2.78 |
| 2408 | 2700 | 3008 | 3333 | 3675 | 4033 | 4433 | 4800 | 3.16 |
| 2267 | 2541 | 2831 | 3137 | 3459 | 3796 | 4149 | 4518 | 3.57 |
| 2141 | 2400 | 2674 | 2963 | 3267 | 3585 | 3819 | 4267 | 4.00 |
| 2027 | 2274 | 2533 | 2807 | 3095 | 3396 | 3712 | 4042 | 4.46 |
| 1927 | 2160 | 2407 | 2667 | 2940 | 3227 | 3527 | 3840 | 4.94 |
| 1835 | 2057 | 2292 | 2540 | 2800 | 3073 | 3359 | 3657 | 5.45 |
| 1752 | 1964 | 2188 | 2424 | 2678 | 2933 | 3206 | 3491 | 5.98 |
| 1675 | 1878 | 2093 | 2319 | 2557 | 2806 | 3067 | 3339 | 6.53 |
| 1606 | 1800 | 2006 | 2222 | 2450 | 2689 | 2939 | 3200 | 7.12 |
| 1541 | 1728 | 1925 | 2133 | 2352 | 2581 | 2821 | 3072 | 7.72 |
| 1482 | 1662 | 1851 | 2051 | 2262 | 2482 | 2713 | 2954 | 8.35 |
| 1427 | 1600 | 1783 | 1975 | 2178 | 2390 | 2612 | 2844 | 9.01 |
| 1376 | 1543 | 1719 | 1905 | 2100 | 2305 | 2519 | 2743 | 9.68 |
| 1329 | 1490 | 1660 | 1839 | 2028 | 2225 | 2432 | 2648 | 10.39 |
| 1284 | 1440 | 1604 | 1778 | 1960 | 2151 | 2351 | 2560 | 11.12 |
| 1243 | 1394 | 1553 | 1720 | 1897 | 2082 | 2275 | 2477 | 11.87 |
| 1204 | 1350 | 1504 | 1667 | 1838 | 2017 | 2217 | 2400 | 12.65 |
| 1168 | 1309 | 1459 | 1616 | 1785 | 1956 | 2137 | 2327 | 13.45 |
| 1133 | 1271 | 1416 | 1569 | 1729 | 1898 | 2075 | 2259 | 14.28 |
| 1101 | 1234 | 1375 | 1524 | 1680 | 1844 | 2013 | 2194 | 15.13 |
| 1070 | 1200 | 1337 | 1481 | 1633 | 1793 | 1909 | 2133 | 16.01 |
| 1041 | 1168 | 1301 | 1441 | 1589 | 1744 | 1906 | 2076 | 16.91 |
| 1014 | 1137 | 1267 | 1404 | 1547 | 1698 | 1856 | 2021 | 17.84 |
| 988 | 1108 | 1234 | 1368 | 1508 | 1655 | 1809 | 1969 | 18.79 |
| 963 | 1080 | 1203 | 1333 | 1470 | 1613 | 1763 | 1920 | 19.76 |

*Safe load for* beams of Hemlock ½ of above.

## STRENGTH OF SOLID WOODEN COLUMNS OF DIFFERENT KINDS OF TIMBER

For various values of $\frac{l}{d}$

$l$ = length of column in inches. $d$ = least diameter in inches.

BASED ON THE FORMULA OF A. L. JOHNSON, C. E., U. S. DEPARTMENT OF AGRICULTURE, DIVISION OF FORESTRY.

$$P = F \times \frac{700 + 15c}{700 + 15c + c^2}$$

$P$ = ultimate strength in pounds per square inch.

$F$ = ultimate crushing strength of timber. $c = \frac{l}{d}$.

Values of F are those given in table on pages 322 and 323 herein.

| | Ultimate Strength in Pounds per Square Inch. | | | | |
|---|---|---|---|---|---|
| | Douglas, Oregon and Washington Yellow Fir or Pine. | Southern, Long Leaf or Georgia Yellow Pine, Canadian (Ottowa) White Pine, Canadian (Ontario) Red Pine. | White Oak. | Northern or Short Leaf Yellow Pine, Red Pine, Norway Pine, Spruce and Eastern Fir, Hemlock, Cypress, Cedar, California Redwood, California Spruce. | White Pine. |
| F | 6000 | 5000 | 4500 | 4000 | 3500 |
| $\frac{l}{d}$ | | | | | |
| 2 | 5967 | 4973 | 4475 | 3978 | 3481 |
| 3 | 5928 | 4940 | 4446 | 3952 | 3458 |
| 4 | 5876 | 4897 | 4407 | 3918 | 3428 |
| 5 | 5813 | 4844 | 4359 | 3875 | 3391 |
| 6 | 5739 | 4782 | 4304 | 3826 | 3347 |
| 7 | 5656 | 4713 | 4242 | 3770 | 3299 |
| 8 | 5566 | 4638 | 4174 | 3710 | 3247 |
| 9 | 5469 | 4558 | 4102 | 3646 | 3190 |
| 10 | 5368 | 4474 | 4026 | 3579 | 3132 |
| 11 | 5264 | 4386 | 3948 | 3509 | 3070 |
| 12 | 5156 | 4297 | 3867 | 3438 | 3008 |
| 13 | 5047 | 4206 | 3785 | 3365 | 2944 |
| 14 | 4937 | 4114 | 3703 | 3291 | 2880 |
| 15 | 4826 | 4022 | 3620 | 3217 | 2815 |
| 16 | 4716 | 3930 | 3537 | 3144 | 2751 |
| 17 | 4606 | 3838 | 3455 | 3071 | 2687 |
| 18 | 4498 | 3748 | 3373 | 2998 | 2624 |
| 19 | 4391 | 3659 | 3293 | 2927 | 2561 |

*For safety factors* for various classes of structures to be used in connection with the above table, see p. 321.

## STRENGTH OF SOLID WOODEN COLUMNS OF DIFFERENT KINDS OF TIMBER

For various values of $\frac{l}{d}$

l = length of column in inches. d = least diameter in inches.

BASED ON THE FORMULA OF A. L. JOHNSON, C. E., U. S. DEPARTMENT OF AGRICULTURE, DIVISION OF FORESTRY.

$$P = F \times \frac{700 + 15c}{700 + 15c + c^2}$$

P = ultimate strength in pounds per square inch.

F = ultimate crushing strength of timber. $c = \frac{l}{d}$.

Values of F are those given in table on pages 822 and 823 herein.

| | Ultimate Strength in Pounds per Square Inch. | | | | |
|---|---|---|---|---|---|
| | Douglas, Oregon and Washington Yellow Fir or Pine. | Southern, Long Leaf or Georgia Yellow Pine, Canadian (Ottowa) White Pine, Canadian (Ontario) Red Pine. | White Oak. | Northern or Short Leaf Yellow Pine, Red Pine, Norway Pine, Spruce and Eastern Fir, Hemlock, Cypress, Cedar, California Redwood, California Spruce. | White Pine. |
| F | 6000 | 5000 | 4500 | 4000 | 3500 |
| $\frac{l}{d}$ | | | | | |
| 20 | 4286 | 3571 | 3214 | 2857 | 2500 |
| 21 | 4183 | 3486 | 3137 | 2788 | 2440 |
| 22 | 4082 | 3402 | 3061 | 2721 | 2381 |
| 23 | 3983 | 3320 | 2988 | 2656 | 2324 |
| 24 | 3888 | 3240 | 2916 | 2592 | 2268 |
| 25 | 3794 | 3162 | 2846 | 2529 | 2213 |
| 26 | 3703 | 3086 | 2777 | 2469 | 2160 |
| 27 | 3615 | 3013 | 2711 | 2410 | 2109 |
| 28 | 3529 | 2941 | 2647 | 2353 | 2059 |
| 29 | 3446 | 2872 | 2585 | 2298 | 2010 |
| 30 | 3366 | 2805 | 2524 | 2244 | 1963 |
| 32 | 3212 | 2677 | 2409 | 2142 | 1874 |
| 34 | 3068 | 2557 | 2301 | 2046 | 1790 |
| 36 | 2934 | 2445 | 2200 | 1956 | 1711 |
| 38 | 2808 | 2340 | 2106 | 1872 | 1638 |
| 40 | 2690 | 2241 | 2017 | 1793 | 1569 |
| 42 | 2579 | 2149 | 1934 | 1719 | 1505 |
| 44 | 2476 | 2063 | 1857 | 1650 | 1444 |
| 46 | 2379 | 1982 | 1784 | 1586 | 1388 |
| 48 | 2288 | 1907 | 1716 | 1525 | 1335 |
| 50 | 2203 | 1835 | 1652 | 1488 | 1285 |

*For safety factors for various classes of structures to be used in connection with the above table, see p. 820.*

## SPECIFIC GRAVITIES AND WEIGHTS OF VARIOUS SUBSTANCES.

| The Basis for Specific Gravities is Pure Water at 62 degrees Fah., Barometer 30 Inches. Weight of One Cubic Foot, 62.355 Pounds. | Average Specific Gravity. Water = 1. | Average Weight of Cubic Foot Pounds. |
|---|---|---|
| Air, atmospheric at 60 degrees F., under pressure of one atmosphere, or 14.7 pounds per square inch, weighs $\frac{1}{815}$th as much as water. | .00123 | .076 |
| Aluminum | 2.6 | 162 |
| Anthracite, 1.3 to 1.84; of Penn, 1.3 to 1.7 | 1.5 | 93.5 |
| " broken, of any size, loose | ..... | 52 to 5 |
| " " moderately shaken | ..... | 56 to 6 |
| " " heaped bushel, loose, 77 to 83 pounds | ..... | ..... |
| " " a ton loose occupies 40 to 43 cubic feet | ..... | ..... |
| Antimony, cast | 6.70 | 418 |
| " native | 6.67 | 416 |
| Ash, perfectly dry (see note p. 335) | .752 | 47 |
| " American white dry (see note p. 335) | .61 | 38 |
| Ashes of soft coal, solidly packed | | 40 to 45 |
| Asphaltum, 1 to 1.8 | 1.4 | 87.3 |
| Brass (copper and zinc) cast 7.8 to 8.4 | 8.1 | 504 |
| " rolled | 8.4 | 524 |
| Brick, best pressed | ..... | 150 |
| " common and hard | ..... | 125 |
| " soft inferior | ..... | 100 |
| Brickwork, pressed brick, fine joints | ..... | 140 |
| " medium quality | ..... | 125 |
| " coarse, inferior, soft | ..... | 100 |
| " at 125 pounds per cubic foot, 1 cubic yard equals 1.507 tons, and 17.92 cubic feet equal 1 ton | ..... | ..... |
| Bronze, copper 8, tin 1 (gun metal) | 8.5 | 529 |
| Cement, hydraulic. American, Rosendale, ground and loose | ..... | 56 |
| " hydraulic. American, Rosendale, U. S. struck bush, 70 pounds | ..... | ..... |
| " hydraulic. American, Rosendale, Louisville bushel 62 pounds | ..... | ..... |
| " hydraulic. American, Cumberland, ground, loose | ..... | 65 |
| " hydraulic. American, Cumberland, ground, thoroughly shaken | ..... | 85 |
| " hydraulic. English Portland (U. S. struck bushel 100 to 128) | ..... | 81 to 10 |
| " hydraulic. English Portland, a barrel 400 to 430 pounds | ..... | ..... |
| " hydraulic. American Portland, loose | ..... | 93 |

## SPECIFIC GRAVITIES AND WEIGHTS OF VARIOUS SUBSTANCES.

| Basis for Specific Gravities is Pure Water at 62 degrees Fah., Barometer 30 Inches. Weight of One Cubic Foot, 62.355 Pounds. | Average Specific Gravity. Water = 1. | Average Weight of One Cubic Foot. Pounds. |
|---|---|---|
| ment, hydraulic. American Portland, thoroughly shaken | ..... | 110 |
| arcoal of pines and oaks | ..... | 15 to 30 |
| alk | 2.5 | 156 |
| erry, perfectly dry (see note p. 335) | .672 | 42 |
| estnut, perfectly dry (see note p. 335) | .660 | 41 |
| ay, potters', dry, 1.8 to 2.1 | 1.9 | 119 |
| " dry in lump, loose | ..... | 63 |
| al, bituminous, solid, 1.2 to 1.5 | 1.35 | 84 |
| " bituminous, solid, Cambria Co., Pa., 1.27–1.34 | ..... | 79 to 84 |
| " bituminous, broken, of any size, loose | ..... | 47 to 52 |
| " bituminous, moderately shaken | ..... | 51 to 56 |
| " bituminous, a heaped bushel, loose, 70 to 78 | ..... | ..... |
| " bituminous, 1 ton occupies 43 to 48 cubic feet | ..... | ..... |
| oke, loose, good quality | ..... | 23 to 32 |
| " loose, a heaped bushel, 35 to 42 | ..... | ..... |
| " 1 ton occupies 80 to 97 cubic feet | ..... | ..... |
| orundum, pure, 3.8 to 4 | 3.9 | ..... |
| opper, cast, 8.6 to 8.8 | 8.7 | 542 |
| " rolled, 8.8 to 9 | 8.9 | 555 |
| ork, dry (see note p. 335) | .24 | 15 |
| press, American (see note p. 335) | .55 | 64 |
| arth, common loam, perfectly dry, loose | ..... | 72 to 80 |
| " " " perfectly dry, shaken | ..... | 82 to 92 |
| " " " perfectly dry, rammed | ..... | 90 to 100 |
| " " " slightly moist, loose | ..... | 70 to 76 |
| " " " more moist, loose | ..... | 66 to 68 |
| " " " more moist, shaken | ..... | 75 to 90 |
| " " " more moist, packed | ..... | 90 to 100 |
| " " " as soft flowing mud | ..... | 104 to 112 |
| " " " as soft flowing mud well pressed | ..... | 110 to 120 |
| m, perfectly dry (see note p. 335) | .56 | 35 |
| nt | 2.6 | 162 |
| ass, 2.5 to 3.45 | 2.93 | 186 |
| " common window | 2.52 | 157 |
| eiss, common, 2.62 to 2.76 | 2.69 | 168 |
| " in loose piles | ..... | 96 |
| old, cast, pure or 24 karat | 19.258 | 1204 |
| " *pure, hammered* | 19.5 | 1217 |
| *anite, 2.56 to 2.88* | 2.72 | 170 |

## SPECIFIC GRAVITIES AND WEIGHTS OF VARIOUS SUBSTANCES.

| The Basis for Specific Gravities is Pure Water at 62 degrees Fah., Barometer 30 Inches. Weight of One Cubic Foot, 62.355 Pounds. | Average Specific Gravity. Water = 1. | Average Weight of One Cubic Foot. Pounds. |
|---|---|---|
| Greenstone, trap, 2.8 to 3.2 | 3.00 | 187 |
| Gypsum, plaster of Paris, 2.24 to 2.30 | 2.27 | 141.6 |
| Hemlock, perfectly dry (see note p. 335) | .4 | 25 |
| Hickory, " " " " | .85 | 53 |
| Ice, .917 to .922 | .92 | 57.4 |
| Iron, cast, 6.9 to 7.4 | 7.15 | 446 |
| " grey foundry, cold | 7.21 | 450 |
| " " molten | 6.94 | 433 |
| " wrought | 7.69 | 480 |
| Lead, commercial | 11.38 | 709.6 |
| Lignumvitæ (dry) | .65–1.33 | 41 to 83 |
| Limestone and marbles | 2.6 | 164.4 |
| Lime, quick | 1.5 | 95 |
| " quick, ground, well shaken, per struck bushel 80 pounds | ..... | 64 |
| " quick, ground, thoroughly shaken, per struck bushel 93⅓ pounds | ..... | 75 |
| Locust, dry (see note p. 335) | .71 | 44 |
| Mahogany, Spanish, dry (see note p. 335) | .85 | 53 |
| " Honduras, dry (see note p. 335) | .56 | 35 |
| Maple, dry (see note p. 335) | .79 | 49 |
| Marbles (see Limestone) | | |
| Masonry of granite or limestones, well-dressed | ..... | 165 |
| " of granite, well-scabbled mortar rubble, about ⅓ of mass will be mortar | ..... | 154 |
| " of granite, well-scabbled dry rubble | ..... | 138 |
| " of granite, roughly scabbled mortar rubble, about ¼ to ⅓ of mass will be mortar | ..... | 150 |
| " of granite, scabbled dry rubble | ..... | 125 |
| " of sandstone, ⅛ less than granite | ..... | ..... |
| Masonry of brickwork (see Brickwork) | | |
| Mercury, at 32 degrees Fah | 13.62 | 849 |
| Mica, 2.75 to 3.1 | 2.93 | 183 |
| Mortar, hardened, 1.4 to 1.9 | 1.65 | 103 |
| Mud, dry, close | ..... | 80 to 110 |
| " wet, moderately pressed | ..... | 110 to 130 |
| " " fluid | ..... | 104 to 120 |
| Oak, live, perfectly dry, .88–1.02 (see note p. 335) | .95 | 59.3 |
| " white, perfectly dry, .66 to .88 (see note p. 335) | .77 | 48 |
| " red, black, perfectly dry | ..... | 32 to 45 |
| *Petroleum* | .878 | 54.8 |

## SPECIFIC GRAVITIES AND WEIGHTS OF VARIOUS SUBSTANCES.

| Basis for Specific Gravities is Pure Water at 62 degrees Fah., Barometer 30 Inches. Weight of One Cubic Foot, 62.355 Pounds. | Average Specific Gravity. Water = 1. | Average Weight of One Cubic Foot. Pounds. |
|---|---|---|
| e, white, perfectly dry, .35 to .45 (see note below) | .40 | 25 |
| yellow, Northern, perfectly dry, .48 to .62 (see note below) | .55 | 34.3 |
| yellow, Southern, perfectly dry, .64 to .8 (see note below) | .72 | 45 |
| :h | 1.15 | 71.7 |
| ılar, dry (see note below) | .47 | 29 |
| tinum | 21.5 | 1342 |
| ırtz | 2.65 | 165 |
| iin. | 1.10 | 68.6 |
| :, coarse, (per struck bushel, Syracuse, N.Y., 6 pounds) | ..... | 45 |
| d, of pure quartz, perfectly dry and loose | ..... | 90 to 106 |
| " " voids full of water | ..... | 118 to 129 |
| " " very large and small grains, dry | ..... | 117 |
| dstone, 2.1 to 2.73, 131 to 171 | 2.41 | 151 |
| " quarried and piled, 1 measure solid makes 1½ (about) piled | ..... | 86 |
| w, fresh fallen | ..... | 5 to 12 |
| moistened, compacted by rain | ..... | 15 to 50 |
| amore, perfectly dry (see note below) | .59 | 37 |
| les, red or black, 2.4 to 2.8 | 2.6 | 162 |
| er | 10.5 | 655 |
| e, 2.7 to 2.9 | 2.8 | 175 |
| pstone, 2.65 to 2.8 | 2.73 | 170 |
| ace, perfectly dry (see note below) | .4 | 25 |
| el | 7.85 | 490 |
| ohur | 2.00 | 125 |
| low | .94 | 58.6 |
| | 1 | 62.355 |
| , cast, 7.2 to 7.5 | 7.35 | 459 |
| lnut, black, perfectly dry (see note below) | .61 | 38 |
| ter, pure rain, distilled, at 32 degrees F., Bar. 30 inches. | ..... | 62.417 |
| " " at 62 degrees F., Bar. 30 inches. | 1 | 62.355 |
| " " at 212 degrees F., Bar. 30 inches. | ..... | 59.7 |
| sea, 1.026 to 1.030 | 1.028 | 64.08 |
| : or spelter, 6.8 to 7.2 | 7.00 | 437.5 |

NOTE.—*Green timbers usually weigh* from one-fifth to nearly one-half more than *ordinary building timbers,* tolerably seasoned, one-sixth more.

## STANDARD DECIMAL GAUGE.

| Standard Decimal Gauge in Inches. | Thickness in Fractions of an Inch. | Approximate Thickness in Millimetres. | Weight per Square Foot in Pounds, Avoirdupois. | |
|---|---|---|---|---|
| | | | IRON. Basis—480 Pounds per Cubic Foot. | STEEL. Basis—489.6 Pounds per Cubic Foot. |
| .002 | 1-500 | .05080010 | .08 | .0816 |
| .004 | 1-250 | .10160020 | .16 | .1632 |
| .006 | 3-500 | .15240030 | .24 | .2448 |
| .008 | 1-125 | .20320041 | .32 | .3264 |
| .010 | 1-100 | .25400051 | .40 | .4080 |
| .012 | 3-250 | .30480061 | .48 | .4896 |
| .014 | 7-500 | .35560071 | .56 | .5712 |
| .016 | 2-125($\frac{1}{64}$+) | .40640081 | .64 | .6528 |
| .018 | 9-500 | .45720091 | .72 | .7344 |
| .020 | 1-50 | .50800102 | .80 | .8160 |
| .022 | 11-500 | .55880112 | .88 | .8976 |
| .025 | 1-40 | .63500127 | 1.00 | 1.0200 |
| .028 | 7-250 | .71120142 | 1.12 | 1.1424 |
| .032 | 4-125($\frac{1}{32}$+) | .81280163 | 1.28 | 1.3056 |
| .036 | 9-250 | .91440183 | 1.44 | 1.4688 |
| .040 | 1-25 | 1.01600203 | 1.60 | 1.6320 |
| .045 | 9-200 | 1.14300229 | 1.80 | 1.8360 |
| .050 | 1-20 | 1.27000254 | 2.00 | 2.0400 |
| .055 | 11-200 | 1.39700280 | 2.20 | 2.2440 |
| .060 | 3-50 ($\frac{1}{16}$—) | 1.52400305 | 2.40 | 2.4480 |
| .065 | 13-200 | 1.65100330 | 2.60 | 2.6520 |
| .070 | 7-100 | 1.77800356 | 2.80 | 2.8560 |
| .075 | 3-40 | 1.90500381 | 3.00 | 3.0600 |
| .080 | 2-25 | 2.03200406 | 3.20 | 3.2640 |
| .085 | 17-200 | 2.15900432 | 3.40 | 3.4680 |
| .090 | 9-100 | 2.28600457 | 3.60 | 3.6720 |
| .095 | 19-200 | 2.41300483 | 3.80 | 3.8760 |
| .100 | 1-10 | 2.54000508 | 4.00 | 4.0800 |
| .110 | 11-100 | 2.79400559 | 4.40 | 4.4880 |
| .125 | 1-8 | 3.17500630 | 5.00 | 5.1000 |
| .135 | 27-200 | 3.42900686 | 5.40 | 5.5080 |
| .150 | 3-20 | 3.81000762 | 6.00 | 6.1200 |
| .165 | 33-200 | 4.19100838 | 6.60 | 6.7320 |
| .180 | 9-50 | 4.57200914 | 7.20 | 7.3440 |
| .200 | 1-5 | 5.08001016 | 8.00 | 8.1600 |
| .220 | 11-50 | 5.58801118 | 8.80 | 8.9760 |
| .240 | 6-25 | 6.09601219 | 9.60 | 9.7920 |
| .250 | 1-4 | 6.35001270 | 10.00 | 10.2000 |

The Standard Decimal Gauge has been recently adopted by the Association of American Steel Manufacturers, the American Railway Master Mechanics' Association and by about seventy-two of the principal railroads of the United States, Canada and Mexico. The decimal system of gauging was recommended by the American Institute of Mining Engineers in 1877 and by the American Society of Mechanical Engineers in 1895.

# WIRE AND SHEET METAL GAUGES.

## In Decimals of an Inch.

| Number of Gauge. | Birmingham or Stubs Iron Wire Gauge. | American or Brown & Sharpe Wire Gauge. | United States Standard Gauge for Sheet and Plate Iron and Steel. | Washburn & Moen Manufacturing Co. and John A. Roebling's Sons Co. Wire Gauge. | Trenton Iron Co. Wire Gauge. | American Screw Co. Screw Wire Gauge. | British Imperial or English Legal Standard Wire Gauge. |
|---|---|---|---|---|---|---|---|
| 00000 | . . . | . . . . . | .5 | . . . . . | . . . . | . . . . | .500 |
| 0000 | . . . | . . . . . | .46875 | .4600 | . . . . | . . . . | .464 |
| 000 | . . . | . . . . . | .4375 | .4300 | .450 | . . . . | .432 |
| 0000 | .454 | .460000 | .40625 | .3938 | .400 | . . . . | .400 |
| 000 | .425 | .409642 | .375 | .3625 | .360 | .0315 | .372 |
| 00 | .380 | .364796 | .34375 | .3310 | .330 | .0447 | .348 |
| 0 | .340 | .324861 | .3125 | .3065 | .305 | .0578 | .324 |
| 1 | .300 | .289297 | .28125 | .2830 | .285 | .0710 | .300 |
| 2 | .284 | .257627 | .265625 | .2625 | .265 | .0842 | .276 |
| 3 | .259 | .229423 | .25 | .2437 | .245 | .0973 | .252 |
| 4 | .238 | .204307 | .234375 | .2253 | .225 | .1105 | .232 |
| 5 | .220 | .181940 | .21875 | .2070 | .205 | .1236 | .212 |
| 6 | .203 | .162023 | .203125 | .1920 | .190 | .1368 | .192 |
| 7 | .180 | .144285 | .1875 | .1770 | .175 | .1500 | .176 |
| 8 | .165 | .128490 | .171875 | .1620 | .160 | .1631 | .160 |
| 9 | .148 | .114423 | .15625 | .1483 | .145 | .1763 | .144 |
| 10 | .134 | .101897 | .140625 | .1350 | .130 | .1894 | .128 |
| 11 | .120 | .090742 | .125 | .1205 | .1175 | .2026 | .116 |
| 12 | .109 | .080808 | .109375 | .1055 | .105 | .2158 | .104 |
| 13 | .095 | .071962 | .09375 | .0915 | .0925 | .2289 | .092 |
| 14 | .083 | .064084 | .078125 | .0800 | .0806 | .2421 | .080 |
| 15 | .072 | .057068 | .0703125 | .0720 | .070 | .2552 | .072 |
| 16 | .065 | .050821 | .0625 | .0625 | .061 | .2684 | .064 |
| 17 | .058 | .045257 | .05625 | .0540 | .0525 | .2816 | .056 |
| 18 | .049 | .040303 | .05 | .0475 | .045 | .2947 | .048 |
| 19 | .042 | .035890 | .04375 | .0410 | .040 | .3079 | .040 |
| 20 | .035 | .031961 | .0375 | .0348 | .035 | .3210 | .036 |
| 21 | .032 | .028462 | .034375 | .03175 | .031 | .3342 | .032 |
| 22 | .028 | .025346 | .03125 | .0286 | .028 | .3474 | .028 |
| 23 | .025 | .022572 | .028125 | .0258 | .025 | .3605 | .024 |
| 24 | .022 | .020101 | .025 | .0230 | .0225 | .3737 | .022 |
| 25 | .020 | .017900 | .021875 | .0204 | .020 | .3868 | .020 |
| 26 | .018 | .015941 | .01875 | .0181 | .018 | .4000 | .018 |
| 27 | .016 | .014195 | .0171875 | .0173 | .017 | .4132 | .0164 |
| 28 | .014 | .012641 | .015625 | .0162 | .016 | .4263 | .0148 |
| 29 | .013 | .011257 | .0140625 | .0150 | .015 | .4395 | .0136 |
| 30 | .012 | .010025 | .0125 | .0140 | .014 | .4526 | .0124 |
| 31 | .010 | .008928 | .0109375 | .0132 | .013 | .4658 | .0116 |
| 32 | .009 | .007950 | .01015625 | .0128 | .012 | .4790 | .0108 |
| 33 | .008 | .007080 | .009375 | .0118 | .011 | .4921 | .0100 |
| 34 | .007 | .006305 | .00859375 | .0104 | .010 | .5053 | .0092 |
| 35 | .005 | .005615 | .0078125 | .0095 | .0095 | .5184 | .0084 |
| 36 | .004 | .005000 | .00703125 | .0090 | .009 | .5316 | .0076 |
| 37 | . . . | .004453 | .006640625 | .0085 | .0085 | .5448 | .0068 |
| 38 | . . . | .003965 | .00625 | .0080 | .008 | .5579 | .0060 |
| 39 | . . . | .003531 | . . . . . | .0075 | .0075 | .5711 | .0052 |
| 40 | . . . | .003144 | . . . . . | .0070 | .007 | .5842 | .0048 |

The United States Standard Gauge was legalized by Act of Congress March 3, 1893, as a standard gauge for sheet and plate iron and steel and is used by the Custom House Department and by about forty-five sheet and tin-plate manufacturers.

## WEIGHTS OF SHEETS AND PLATES OF STEEL, WROUGHT IRON, COPPER AND BRASS.

AMERICAN OR BROWNE & SHARPE GAUGE.

| No. of Gauge. | Thickness in Inches. | Weight per Square Foot. | | | |
|---|---|---|---|---|---|
| | | Steel. | Iron. | Copper. | Brass. |
| 0000 | .460000 | 18.7680 | 18.4000 | 20.8380 | 19.6880 |
| 000 | .409642 | 16.7134 | 16.3857 | 18.5568 | 17.5327 |
| 00 | .364796 | 14.8837 | 14.5918 | 16.5253 | 15.6133 |
| 0 | .324861 | 13.2543 | 12.9944 | 14.7162 | 13.9041 |
| 1 | .289297 | 11.8033 | 11.5719 | 13.1052 | 12.3819 |
| 2 | .257627 | 10.5112 | 10.3051 | 11.6705 | 11.0264 |
| 3 | .229423 | 9.3605 | 9.1769 | 10.3929 | 9.8193 |
| 4 | .204307 | 8.3357 | 8.1723 | 9.2551 | 8.7443 |
| 5 | .181940 | 7.4232 | 7.2776 | 8.2419 | 7.7870 |
| 6 | .162023 | 6.6105 | 6.4809 | 7.3396 | 6.9346 |
| 7 | .144285 | 5.8868 | 5.7714 | 6.5361 | 6.1754 |
| 8 | .128490 | 5.2424 | 5.1396 | 5.8206 | 5.4994 |
| 9 | .114423 | 4.6685 | 4.5769 | 5.1834 | 4.8973 |
| 10 | .101897 | 4.1574 | 4.0759 | 4.6159 | 4.3612 |
| 11 | .090742 | 3.7023 | 3.6297 | 4.1106 | 3.8838 |
| 12 | .080808 | 3.2970 | 3.2323 | 3.6606 | 3.4586 |
| 13 | .071962 | 2.9360 | 2.8785 | 3.2599 | 3.0800 |
| 14 | .064084 | 2.6146 | 2.5634 | 2.9030 | 2.7428 |
| 15 | .057068 | 2.3284 | 2.2827 | 2.5852 | 2.4425 |
| 16 | .050821 | 2.0735 | 2.0328 | 2.3022 | 2.1751 |
| 17 | .045257 | 1.8465 | 1.8103 | 2.0501 | 1.9370 |
| 18 | .040303 | 1.6444 | 1.6121 | 1.8257 | 1.7250 |
| 19 | .035890 | 1.4643 | 1.4356 | 1.6258 | 1.5361 |
| 20 | .031961 | 1.3040 | 1.2784 | 1.4478 | 1.3679 |
| 21 | .028462 | 1.1612 | 1.1385 | 1.2893 | 1.2182 |
| 22 | .025346 | 1.0341 | 1.0138 | 1.1482 | 1.0848 |
| 23 | .022572 | .92094 | .90288 | 1.0225 | .96608 |
| 24 | .020101 | .82012 | .80404 | .91058 | .86032 |
| 25 | .017900 | .73032 | .71600 | .81087 | .76612 |
| 26 | .015941 | .65039 | .63764 | .72213 | .68227 |
| 27 | .014195 | .57916 | .56780 | .64303 | .60755 |
| 28 | .012641 | .51575 | .50564 | .57264 | .54103 |
| 29 | .011257 | .45929 | .45028 | .50994 | .48180 |
| 30 | .010025 | .40902 | .40100 | .45413 | .42907 |
| 31 | .008928 | .36426 | .35712 | .40444 | .38212 |
| 32 | .007950 | .32436 | .31800 | .36014 | .34026 |
| 33 | .007080 | .28886 | .28320 | .32072 | .30302 |
| 34 | .006305 | .25724 | .25220 | .28562 | .26985 |
| 35 | .005615 | .22909 | .22460 | .25436 | .24032 |
| 36 | .005000 | .20400 | .20000 | .22650 | .21400 |
| 37 | .004453 | .18168 | .17812 | .20172 | .19059 |
| 38 | .003965 | .16177 | .15860 | .17961 | .16970 |
| 39 | .003531 | .14406 | .14124 | .15995 | .15113 |
| 40 | .003144 | 12828 | .12576 | .14242 | .13456 |

*For weights of steel plates from $\frac{1}{16}$" to 2" thick, see "Table of Weights of Flattened Bars," pages 359–368.*

# WEIGHTS OF SHEETS AND PLATES OF L, WROUGHT IRON, COPPER AND BRASS.

BIRMINGHAM GAUGE.

| Thickness in Inches. | Weight per Square Foot. | | | |
|---|---|---|---|---|
| | Steel. | Iron. | Copper. | Brass. |
| .454 | 18.5232 | 18.16 | 20.5662 | 19.4312 |
| .425 | 17.3400 | 17.00 | 19.2525 | 18.1900 |
| .380 | 15.5040 | 15.20 | 17.2140 | 16.2640 |
| .340 | 13.8720 | 13.60 | 15.4020 | 14.5520 |
| .300 | 12.2400 | 12.00 | 13.5900 | 12.8400 |
| .284 | 11.5872 | 11.36 | 12.8652 | 12.1552 |
| .259 | 10.5672 | 10.36 | 11.7327 | 11.0852 |
| .238 | 9.7104 | 9.52 | 10.7814 | 10.1864 |
| .220 | 8.9760 | 8.80 | 9.966 | 9.4160 |
| .203 | 8.2824 | 8.12 | 9.1959 | 8.6884 |
| .180 | 7.3440 | 7.20 | 8.1540 | 7.7040 |
| .165 | 6.7320 | 6.60 | 7.4745 | 7.0620 |
| .148 | 6.0384 | 5.92 | 6.7044 | 6.3344 |
| .134 | 5.4672 | 5.36 | 6.0702 | 5.7352 |
| .120 | 4.8960 | 4.80 | 5.4360 | 5.1360 |
| .109 | 4.4472 | 4.36 | 4.9377 | 4.6652 |
| .095 | 3.8760 | 3.80 | 4.3035 | 4.0660 |
| .083 | 3.3864 | 3.32 | 3.7599 | 3.5524 |
| .072 | 2.9376 | 2.88 | 3.2616 | 3.0816 |
| .065 | 2.6520 | 2.60 | 2.9445 | 2.7820 |
| .058 | 2.3664 | 2.32 | 2.6274 | 2.4824 |
| .049 | 1.9992 | 1.96 | 2.2197 | 2.0972 |
| .042 | 1.7136 | 1.68 | 1.9026 | 1.7976 |
| .035 | 1.4280 | 1.40 | 1.5855 | 1.4980 |
| .032 | 1.3056 | 1.28 | 1.4496 | 1.3696 |
| .028 | 1.1424 | 1.12 | 1.2684 | 1.1984 |
| .025 | 1.0200 | 1.00 | 1.1325 | 1.0700 |
| .022 | .8976 | .88 | .9966 | .9416 |
| .020 | .8160 | .80 | .9060 | .8560 |
| .018 | .7344 | .72 | .8154 | .7704 |
| .016 | .6528 | .64 | .7248 | .6848 |
| .014 | .5712 | .56 | .6342 | .5992 |
| .013 | .5304 | .52 | .5889 | .5564 |
| .012 | .4896 | .48 | .5436 | .5136 |
| .010 | .4080 | .40 | .4530 | .4280 |
| .009 | .3672 | .36 | .4077 | .3852 |
| .008 | .3264 | .32 | .3624 | .3424 |
| .007 | .2856 | .28 | .3171 | .2996 |
| .005 | .2040 | .20 | .2265 | .2140 |
| .004 | .1632 | .16 | .1812 | .1712 |
| avities ..... | 7.85 | 7.70 | 8.72 | 8.24 |
| a Cubic Foot .. | 489.6 | 480.0 | 543.6 | 513.8 |
| " " Inch .. | .2833 | .2778 | .3146 | .2972 |

## DECIMALS OF A FOOT FOR EACH $\frac{1}{64}$ OF AN INCH.

| Inch. | 0″ | 1″ | 2″ | 3″ | 4″ | 5″ |
|---|---|---|---|---|---|---|
| 0 | 0 | .0833 | .1667 | .2500 | .3333 | .4167 |
| $\frac{1}{64}$ | .0013 | .0846 | .1680 | .2513 | .3346 | .4180 |
| $\frac{1}{32}$ | .0026 | .0859 | .1693 | .2526 | .3359 | .4193 |
| $\frac{3}{64}$ | .0039 | .0872 | .1706 | .2539 | .3372 | .4206 |
| $\frac{1}{16}$ | .0052 | .0885 | .1719 | .2552 | .3385 | .4219 |
| $\frac{5}{64}$ | .0065 | .0898 | .1732 | .2565 | .3398 | .4232 |
| $\frac{3}{32}$ | .0078 | .0911 | .1745 | .2578 | .3411 | .4245 |
| $\frac{7}{64}$ | .0091 | .0924 | .1758 | .2591 | .3424 | .4258 |
| $\frac{1}{8}$ | .0104 | .0937 | .1771 | .2604 | .3437 | .4271 |
| $\frac{9}{64}$ | .0117 | .0951 | .1784 | .2617 | .3451 | .4284 |
| $\frac{5}{32}$ | .0130 | .0964 | .1797 | .2630 | .3464 | .4297 |
| $\frac{11}{64}$ | .0143 | .0977 | .1810 | .2643 | .3477 | .4310 |
| $\frac{3}{16}$ | .0156 | .0990 | .1823 | .2656 | .3490 | .4323 |
| $\frac{13}{64}$ | .0169 | .1003 | .1836 | .2669 | .3503 | .4336 |
| $\frac{7}{32}$ | .0182 | .1016 | .1849 | .2682 | .3516 | .4349 |
| $\frac{15}{64}$ | .0195 | .1029 | .1862 | .2695 | .3529 | .4362 |
| $\frac{1}{4}$ | .0208 | .1042 | .1875 | .2708 | .3542 | .4375 |
| $\frac{17}{64}$ | .0221 | .1055 | .1888 | .2721 | .3555 | .4388 |
| $\frac{9}{32}$ | .0234 | .1068 | .1901 | .2734 | .3568 | .4401 |
| $\frac{19}{64}$ | .0247 | .1081 | .1914 | .2747 | .3581 | .4414 |
| $\frac{5}{16}$ | .0260 | .1094 | .1927 | .2760 | .3594 | .4427 |
| $\frac{21}{64}$ | .0273 | .1107 | .1940 | .2773 | .3607 | .4440 |
| $\frac{11}{32}$ | .0286 | .1120 | .1953 | .2786 | .3620 | .4453 |
| $\frac{23}{64}$ | .0299 | .1133 | .1966 | .2799 | .3633 | .4466 |
| $\frac{3}{8}$ | .0312 | .1146 | .1979 | .2812 | .3646 | .4479 |
| $\frac{25}{64}$ | .0326 | .1159 | .1992 | .2826 | .3659 | .4492 |
| $\frac{13}{32}$ | .0339 | .1172 | .2005 | .2839 | .3672 | .4505 |
| $\frac{27}{64}$ | .0352 | .1185 | .2018 | .2852 | .3685 | .4518 |
| $\frac{7}{16}$ | .0365 | .1198 | .2031 | .2865 | .3698 | .4531 |
| $\frac{29}{64}$ | .0378 | .1211 | .2044 | .2878 | .3711 | .4544 |
| $\frac{15}{32}$ | .0391 | .1224 | .2057 | .2891 | .3724 | .4557 |
| $\frac{31}{64}$ | .0404 | .1237 | .2070 | .2904 | .3737 | .4570 |
| $\frac{1}{2}$ | .0417 | .1250 | .2083 | .2917 | .3750 | .4583 |

## DECIMALS OF A FOOT FOR EACH $\frac{1}{64}$ OF AN INCH.

| Inch. | 6″ | 7″ | 8″ | 9″ | 10″ | 11″ |
|---|---|---|---|---|---|---|
| 0 | .5000 | .5833 | .6667 | .7500 | .8333 | .9167 |
| $\frac{1}{64}$ | .5013 | .5846 | .6680 | .7513 | .8346 | .9180 |
| $\frac{1}{32}$ | .5026 | .5859 | .6693 | .7526 | .8359 | .9193 |
| $\frac{3}{64}$ | .5039 | .5872 | .6706 | .7539 | .8372 | .9206 |
| $\frac{1}{16}$ | .5052 | .5885 | .6719 | .7552 | .8385 | .9219 |
| $\frac{5}{64}$ | .5065 | .5898 | .6732 | .7565 | .8398 | .9232 |
| $\frac{3}{32}$ | .5078 | .5911 | .6745 | .7578 | .8411 | .9245 |
| $\frac{7}{64}$ | .5091 | .5924 | .6758 | .7591 | .8424 | .9258 |
| $\frac{1}{8}$ | .5104 | .5937 | .6771 | .7604 | .8437 | .9271 |
| $\frac{9}{64}$ | .5117 | .5951 | .6784 | .7617 | .8451 | .9284 |
| $\frac{5}{32}$ | .5130 | .5964 | .6797 | .7630 | .8464 | .9297 |
| $\frac{11}{64}$ | .5143 | .5977 | .6810 | .7643 | .8477 | .9310 |
| $\frac{3}{16}$ | .5156 | .5990 | .6823 | .7656 | .8490 | .9323 |
| $\frac{13}{64}$ | .5169 | .6003 | .6836 | .7669 | .8503 | .9336 |
| $\frac{7}{32}$ | .5182 | .6016 | .6849 | .7682 | .8516 | .9349 |
| $\frac{15}{64}$ | .5195 | .6029 | .6862 | .7695 | .8529 | .9362 |
| $\frac{1}{4}$ | .5208 | .6042 | .6875 | .7708 | .8542 | .9375 |
| $\frac{17}{64}$ | .5221 | .6055 | .6888 | .7721 | .8555 | .9388 |
| $\frac{9}{32}$ | .5234 | .6068 | .6901 | .7734 | .8568 | .9401 |
| $\frac{19}{64}$ | .5247 | .6081 | .6914 | .7747 | .8581 | .9414 |
| $\frac{5}{16}$ | .5260 | .6094 | .6927 | .7760 | .8594 | .9427 |
| $\frac{21}{64}$ | .5273 | .6107 | .6940 | .7773 | .8607 | .9440 |
| $\frac{11}{32}$ | .5286 | .6120 | .6953 | .7786 | .8620 | .9453 |
| $\frac{23}{64}$ | .5299 | .6133 | .6966 | .7799 | .8633 | .9466 |
| $\frac{3}{8}$ | .5312 | .6146 | .6979 | .7812 | .8646 | .9479 |
| $\frac{25}{64}$ | .5326 | .6159 | .6992 | .7826 | .8659 | .9492 |
| $\frac{13}{32}$ | .5339 | .6172 | .7005 | .7839 | .8672 | .9505 |
| $\frac{27}{64}$ | .5352 | .6185 | .7018 | .7852 | .8685 | .9518 |
| $\frac{7}{16}$ | .5365 | .6198 | .7031 | .7865 | .8698 | .9531 |
| $\frac{29}{64}$ | .5378 | .6211 | .7044 | .7878 | .8711 | .9544 |
| $\frac{15}{32}$ | .5391 | .6224 | .7057 | .7891 | .8724 | .9557 |
| $\frac{31}{64}$ | .5404 | .6237 | .7070 | .7904 | .8737 | .9570 |
| $\frac{1}{2}$ | .5417 | .6250 | .7083 | .7917 | .8750 | .9583 |

## DECIMALS OF A FOOT FOR EACH $\frac{1}{64}$ AN INCH.

| Inch. | 0″ | 1″ | 2″ | 3″ | 4″ | |
|---|---|---|---|---|---|---|
| $\frac{1}{64}$ | .0430 | .1263 | .2096 | .2930 | .3763 | . |
| $\frac{1}{32}$ | .0443 | .1276 | .2109 | .2943 | .3776 | . |
| $\frac{3}{64}$ | .0456 | .1289 | .2122 | .2956 | .3789 | . |
| $\frac{1}{16}$ | .0469 | .1302 | .2135 | .2969 | .3802 | . |
| $\frac{5}{64}$ | .0482 | .1315 | .2148 | .2982 | .3815 | . |
| $\frac{3}{32}$ | .0495 | .1328 | .2161 | .2995 | .3828 | . |
| $\frac{7}{64}$ | .0508 | .1341 | .2174 | .3008 | .3841 | . |
| $\frac{1}{8}$ | .0521 | .1354 | .2188 | .3021 | .3854 | . |
| $\frac{9}{64}$ | .0534 | .1367 | .2201 | .3034 | .3867 | . |
| $\frac{5}{32}$ | .0547 | .1380 | .2214 | .3047 | .3880 | . |
| $\frac{11}{64}$ | .0560 | .1393 | .2227 | .3060 | .3893 | . |
| $\frac{3}{16}$ | .0573 | .1406 | .2240 | .3073 | .3906 | . |
| $\frac{13}{64}$ | .0586 | .1419 | .2253 | .3086 | .3919 | . |
| $\frac{7}{32}$ | .0599 | .1432 | .2266 | .3099 | .3932 | . |
| $\frac{15}{64}$ | .0612 | .1445 | .2279 | .3112 | .3945 | . |
| $\frac{1}{4}$ | .0625 | .1458 | .2292 | .3125 | .3958 | . |
| $\frac{17}{64}$ | .0638 | .1471 | .2305 | .3138 | .3971 | . |
| $\frac{9}{32}$ | .0651 | .1484 | .2318 | .3151 | .3984 | . |
| $\frac{19}{64}$ | .0664 | .1497 | .2331 | .3164 | .3997 | . |
| $\frac{5}{16}$ | .0677 | .1510 | .2344 | .3177 | .4010 | . |
| $\frac{21}{64}$ | .0690 | .1523 | .2357 | .3190 | .4023 | . |
| $\frac{11}{32}$ | .0703 | .1536 | .2370 | .3203 | .4036 | . |
| $\frac{23}{64}$ | .0716 | .1549 | .2383 | .3216 | .4049 | . |
| $\frac{3}{8}$ | .0729 | .1562 | .2396 | .3229 | .4062 | . |
| $\frac{25}{64}$ | .0742 | .1576 | .2409 | .3242 | .4076 | . |
| $\frac{13}{32}$ | .0755 | .1589 | .2422 | .3255 | .4089 | . |
| $\frac{27}{64}$ | .0768 | .1602 | .2435 | .3268 | .4102 | . |
| $\frac{7}{16}$ | .0781 | .1615 | .2448 | .3281 | .4115 | . |
| $\frac{29}{64}$ | .0794 | .1628 | .2461 | .3294 | .4128 | . |
| $\frac{15}{32}$ | .0807 | .1641 | .2474 | .3307 | .4141 | . |
| $\frac{31}{64}$ | .0820 | .1654 | .2487 | .3320 | .4154 | . |
| 1 | | | | | | |

## DECIMALS OF A FOOT FOR EACH $\frac{1}{64}$ OF AN INCH.

| Inch. | 6″ | 7″ | 8″ | 9″ | 10″ | 11″ |
|---|---|---|---|---|---|---|
| $\frac{1}{64}$ | .5430 | .6263 | .7096 | .7930 | .8763 | .9596 |
| $\frac{1}{32}$ | .5443 | .6276 | .7109 | .7943 | .8776 | .9609 |
| $\frac{3}{64}$ | .5456 | .6289 | .7122 | .7956 | .8789 | .9622 |
| $\frac{1}{16}$ | .5469 | .6302 | .7135 | .7969 | .8802 | .9635 |
| $\frac{5}{64}$ | .5482 | .6315 | .7148 | .7982 | .8815 | .9648 |
| $\frac{3}{32}$ | .5495 | .6328 | .7161 | .7995 | .8828 | .9661 |
| $\frac{7}{64}$ | .5508 | .6341 | .7174 | .8008 | .8841 | .9674 |
| $\frac{1}{8}$ | .5521 | .6354 | .7188 | .8021 | .8854 | .9688 |
| $\frac{9}{64}$ | .5534 | .6367 | .7201 | .8034 | .8867 | .9701 |
| $\frac{5}{32}$ | .5547 | .6380 | .7214 | .8047 | .8880 | .9714 |
| $\frac{11}{64}$ | .5560 | .6393 | .7227 | .8060 | .8893 | .9727 |
| $\frac{3}{16}$ | .5573 | .6406 | .7240 | .8073 | .8906 | .9740 |
| $\frac{13}{64}$ | .5586 | .6419 | .7253 | .8086 | .8919 | .9753 |
| $\frac{7}{32}$ | .5599 | .6432 | .7266 | .8099 | .8932 | .9766 |
| $\frac{15}{64}$ | .5612 | .6445 | .7279 | .8112 | .8945 | .9779 |
| $\frac{1}{4}$ | .5625 | .6458 | .7292 | .8125 | .8958 | .9792 |
| $\frac{17}{64}$ | .5638 | .6471 | .7305 | .8138 | .8971 | .9805 |
| $\frac{9}{32}$ | .5651 | .6484 | .7318 | .8151 | .8984 | .9818 |
| $\frac{19}{64}$ | .5664 | .6497 | .7331 | .8164 | .8997 | .9831 |
| $\frac{5}{16}$ | .5677 | .6510 | .7344 | .8177 | .9010 | .9844 |
| $\frac{21}{64}$ | .5690 | .6523 | .7357 | .8190 | .9023 | .9857 |
| $\frac{11}{32}$ | .5703 | .6536 | .7370 | .8203 | .9036 | .9870 |
| $\frac{23}{64}$ | .5716 | .6549 | .7383 | .8216 | .9049 | .9883 |
| $\frac{3}{8}$ | .5729 | .6562 | .7396 | .8229 | .9062 | .9896 |
| $\frac{25}{64}$ | .5742 | .6576 | .7409 | .8242 | .9076 | .9909 |
| $\frac{13}{32}$ | .5755 | .6589 | .7422 | .8255 | .9089 | .9922 |
| $\frac{27}{64}$ | .5768 | .6602 | .7435 | .8268 | .9102 | .9935 |
| $\frac{7}{16}$ | .5781 | .6615 | .7448 | .8281 | .9115 | .9948 |
| $\frac{29}{64}$ | .5794 | .6628 | .7461 | .8294 | .9128 | .9961 |
| $\frac{15}{32}$ | .5807 | .6641 | .7474 | .8307 | .9141 | .9974 |
| $\frac{31}{64}$ | .5820 | .6654 | .7487 | .8320 | .9154 | .9987 |
| 1 | | | | | | 1.0000 |

## DECIMALS OF AN INCH FOR EACH $\frac{1}{64}$th.

| $\frac{1}{32}$ds. | $\frac{1}{64}$ths. | Decimal. | Fraction. | $\frac{1}{32}$ds. | $\frac{1}{64}$ths. | Decimal. | Fraction. |
|---|---|---|---|---|---|---|---|
| | 1 | .015625 | | | 33 | .515625 | |
| 1 | 2 | .03125 | | 17 | 34 | .53125 | |
| | 3 | .046875 | | | 35 | .546875 | |
| 2 | 4 | .0625 | 1-16 | 18 | 36 | .5625 | 9-16 |
| | 5 | .078125 | | | 37 | .578125 | |
| 3 | 6 | .09375 | | 19 | 38 | .59375 | |
| | 7 | .109375 | | | 39 | .609375 | |
| 4 | 8 | .125 | 1-8 | 20 | 40 | .625 | 5-8 |
| | 9 | .140625 | | | 41 | .640625 | |
| 5 | 10 | .15625 | | 21 | 42 | .65625 | |
| | 11 | .171875 | | | 43 | .671875 | |
| 6 | 12 | .1875 | 3-16 | 22 | 44 | .6875 | 11-16 |
| | 13 | .203125 | | | 45 | .703125 | |
| 7 | 14 | .21875 | | 23 | 46 | .71875 | |
| | 15 | .234375 | | | 47 | .734375 | |
| 8 | 16 | .25 | 1-4 | 24 | 48 | .75 | 3-4 |
| | 17 | .265625 | | | 49 | .765625 | |
| 9 | 18 | .28125 | | 25 | 50 | .78125 | |
| | 19 | .296875 | | | 51 | .796875 | |
| 10 | 20 | .3125 | 5-16 | 26 | 52 | .8125 | 13-16 |
| | 21 | .328125 | | | 53 | .828125 | |
| 11 | 22 | .34375 | | 27 | 54 | .84375 | |
| | 23 | .359375 | | | 55 | .859375 | |
| 12 | 24 | .375 | 3-8 | 28 | 56 | .875 | 7-8 |
| | 25 | .390625 | | | 57 | .890625 | |
| 13 | 26 | .40625 | | 29 | 58 | .90625 | |
| | 27 | .421875 | | | 59 | .921875 | |
| 14 | 28 | .4375 | 7-16 | 30 | 60 | .9375 | 15-16 |
| | 29 | .453125 | | | 61 | .953125 | |
| 15 | 30 | .46875 | | 31 | 62 | .96875 | |
| | 31 | .484375 | | | 63 | .984375 | |
| 16 | 32 | .5 | 1-2 | 32 | 64 | 1. | 1 |

# WEIGHTS AND AREAS OF SQUARE AND ROUND BARS AND CIRCUMFERENCES OF ROUND BARS.

One cubic foot of steel weighs 489.6 lbs.

| Thickness or Diameter in Inches. | Weight of □ Bar One Foot Long. | Weight of ○ Bar One Foot Long. | Area of □ Bar in Sq. Inches. | Area of ○ Bar in Sq. Inches. | Circumference of ○ Bar in Inches. |
|---|---|---|---|---|---|
| 1/16 | .013 | .010 | .0039 | .0031 | .1963 |
| 1/16 | .021 | .016 | .0061 | .0048 | .2454 |
| 3/64 | .030 | .023 | .0088 | .0069 | .2945 |
| 1/16 | .041 | .032 | .0120 | .0094 | .3436 |
| 1/8 | .053 | .042 | .0156 | .0123 | .3927 |
| 9/64 | .067 | .053 | .0198 | .0155 | .4418 |
| 5/32 | .083 | .065 | .0244 | .0192 | .4909 |
| 11/64 | .100 | .079 | .0295 | .0232 | .5400 |
| 3/16 | .120 | .094 | .0352 | .0276 | .5890 |
| 13/64 | .140 | .110 | .0413 | .0324 | .6381 |
| 7/32 | .163 | .128 | .0479 | .0376 | .6872 |
| 15/64 | .187 | .147 | .0549 | .0431 | .7363 |
| 1/4 | .213 | .167 | .0625 | .0491 | .7854 |
| 17/64 | .240 | .188 | .0706 | .0554 | .8345 |
| 9/32 | .269 | .211 | .0791 | .0621 | .8836 |
| 19/64 | .300 | .235 | .0881 | .0692 | .9327 |
| 5/16 | .332 | .261 | .0977 | .0767 | .9817 |
| 21/64 | .366 | .288 | .1077 | .0846 | 1.0308 |
| 11/32 | .402 | .316 | .1182 | .0928 | 1.0799 |
| 23/64 | .439 | .345 | .1292 | .1014 | 1.1290 |
| 3/8 | .478 | .376 | .1406 | .1104 | 1.1781 |
| 25/64 | .519 | .407 | .1526 | .1198 | 1.2272 |
| 13/32 | .561 | .441 | .1650 | .1296 | 1.2763 |
| 27/64 | .605 | .475 | .1780 | .1398 | 1.3254 |
| 7/16 | .651 | .511 | .1914 | .1503 | 1.3744 |
| 29/64 | .698 | .548 | .2053 | .1613 | 1.4235 |
| 15/32 | .747 | .587 | .2197 | .1726 | 1.4726 |
| 31/64 | .798 | .627 | .2346 | .1843 | 1.5217 |
| 1/2 | .850 | .668 | .2500 | .1963 | 1.5708 |
| 33/64 | .904 | .710 | .2659 | .2088 | 1.6199 |
| 17/32 | .960 | .754 | .2822 | .2217 | 1.6690 |
| 35/64 | 1.017 | .799 | .2991 | .2349 | 1.7181 |

## SQUARE AND ROUND BARS.

(CONTINUED.)

| Thickness or Diameter in Inches. | Weight of □ Bar One Foot Long. | Weight of ○ Bar One Foot Long. | Area of □ Bar in Sq. Inches. | Area of ○ Bar in Sq. Inches. | Circumfere of ○ Ba in Inche |
|---|---|---|---|---|---|
| 9/16 | 1.076 | .845 | .3164 | .2485 | 1.767 |
| 37/64 | 1.136 | .893 | .3342 | .2625 | 1.81 |
| 19/32 | 1.199 | .941 | .3525 | .2769 | 1.86 |
| 39/64 | 1.263 | .992 | .3713 | .2916 | 1.91 |
| 5/8 | 1.328 | 1.043 | .3906 | .3068 | 1.96 |
| 41/64 | 1.395 | 1.106 | .4104 | .3252 | 2.01 |
| 21/32 | 1.464 | 1.150 | .4307 | .3382 | 2.06 |
| 43/64 | 1.535 | 1.205 | .4514 | .3545 | 2.11 |
| 11/16 | 1.607 | 1.262 | .4727 | .3712 | 2.15 |
| 45/64 | 1.681 | 1.320 | .4944 | .3883 | 2.20 |
| 23/32 | 1.756 | 1.379 | .5166 | .4057 | 2.25 |
| 47/64 | 1.834 | 1.440 | .5393 | .4236 | 2.30 |
| 3/4 | 1.913 | 1.502 | .5625 | .4418 | 2.35 |
| 13/16 | 2.245 | 1.763 | .6602 | .5185 | 2.55 |
| 7/8 | 2.603 | 2.044 | .7656 | .6013 | 2.74 |
| 15/16 | 2.989 | 2.347 | .8789 | .6903 | 2.94 |
| 1 | 3.400 | 2.670 | 1.0000 | .7854 | 3.14 |
| 1 1/16 | 3.838 | 3.014 | 1.1289 | .8866 | 3.33 |
| 1 1/8 | 4.303 | 3.379 | 1.2656 | .9940 | 3.53 |
| 1 3/16 | 4.795 | 3.766 | 1.4102 | 1.1075 | 3.73 |
| 1 1/4 | 5.312 | 4.173 | 1.5625 | 1.2272 | 3.92 |
| 1 5/16 | 5.857 | 4.600 | 1.7227 | 1.3530 | 4.12 |
| 1 3/8 | 6.428 | 5.049 | 1.8906 | 1.4849 | 4.31 |
| 1 7/16 | 7.026 | 5.518 | 2.0664 | 1.6230 | 4.51 |
| 1 1/2 | 7.650 | 6.008 | 2.2500 | 1.7671 | 4.71 |
| 1 9/16 | 8.301 | 6.520 | 2.4414 | 1.9175 | 4.90 |
| 1 5/8 | 8.978 | 7.051 | 2.6406 | 2.0739 | 5.10 |
| 1 11/16 | 9.682 | 7.604 | 2.8477 | 2.2365 | 5.30 |
| 1 3/4 | 10.41 | 8.178 | 3.0625 | 2.4053 | 5.49 |
| 1 13/16 | 11.17 | 8.773 | 3.2852 | 2.5802 | 5.69 |
| 1 7/8 | 11.95 | 9.388 | 3.5156 | 2.7612 | 5.89 |
| 1 15/16 | 12.76 | 10.02 | 3.7539 | 2.9483 | 6.08 |

## SQUARE AND ROUND BARS.

(CONTINUED.)

| Thickness or Diameter in Inches. | Weight of □ Bar One Foot Long. | Weight of ○ Bar One Foot Long. | Area of □ Bar in Sq. Inches. | Area of ○ Bar in Sq. Inches. | Circumference of ○ Bar in Inches. |
|---|---|---|---|---|---|
| 2 | 13.60 | 10.68 | 4.0000 | 3.1416 | 6.2832 |
| 1/16 | 14.46 | 11.36 | 4.2539 | 3.3410 | 6.4795 |
| 1/8 | 15.35 | 12.06 | 4.5156 | 3.5466 | 6.6759 |
| 3/16 | 16.27 | 12.78 | 4.7852 | 3.7583 | 6.8722 |
| 1/4 | 17.22 | 13.52 | 5.0625 | 3.9761 | 7.0686 |
| 5/16 | 18.19 | 14.28 | 5.3477 | 4.2000 | 7.2649 |
| 3/8 | 19.18 | 15.07 | 5.6406 | 4.4301 | 7.4613 |
| 7/16 | 20.20 | 15.86 | 5.9414 | 4.6664 | 7.6576 |
| 1/2 | 21.25 | 16.69 | 6.2500 | 4.9087 | 7.8540 |
| 9/16 | 22.33 | 17.53 | 6.5664 | 5.1572 | 8.0503 |
| 5/8 | 23.43 | 18.40 | 6.8906 | 5.4119 | 8.2467 |
| 11/16 | 24.56 | 19.29 | 7.2227 | 5.6727 | 8.4430 |
| 3/4 | 25. | 20.20 | 7.5625 | 5.9396 | 8.6394 |
| 13/16 | 26.90 | 21.12 | 7.9102 | 6.2126 | 8.8357 |
| 7/8 | 28.10 | 22.07 | 8.2656 | 6.4918 | 9.0321 |
| 15/16 | 29.34 | 23.04 | 8.6289 | 6.7771 | 9.2284 |
| 3 | 30.60 | 24.03 | 9.0000 | 7.0686 | 9.4248 |
| 1/16 | 31.89 | 25.04 | 9.3789 | 7.3662 | 9.6211 |
| 1/8 | 33.20 | 26.08 | 9.7656 | 7.6699 | 9.8175 |
| 3/16 | 34.55 | 27.13 | 10.160 | 7.9798 | 10.014 |
| 1/4 | 35.92 | 28.20 | 10.563 | 8.2958 | 10.210 |
| 5/16 | 37.31 | 29.30 | 10.973 | 8.6179 | 10.407 |
| 3/8 | 38.73 | 30.42 | 11.391 | 8.9462 | 10.603 |
| 7/16 | 40.18 | 31.56 | 11.816 | 9.2806 | 10.799 |
| 1/2 | 41.65 | 32.71 | 12.250 | 9.6211 | 10.996 |
| 9/16 | 43.14 | 33.90 | 12.691 | 9.9678 | 11.192 |
| 5/8 | 44.68 | 35.09 | 13.141 | 10.321 | 11.388 |
| 11/16 | 46.24 | 36.31 | 13.598 | 10.680 | 11.585 |
| 3/4 | 47.82 | 37.56 | 14.063 | 11.045 | 11.781 |
| 13/16 | 49.42 | 38.81 | 14.535 | 11.416 | 11.977 |
| 7/8 | 51.05 | 40.10 | 15.016 | 11.793 | 12.174 |
| 15/16 | 52.71 | 41.40 | 15.504 | 12.177 | 12.370 |

## SQUARE AND ROUND BARS.

(CONTINUED.)

| Thickness or Diameter in Inches. | Weight of □ Bar One Foot Long. | Weight of ○ Bar One Foot Long. | Area of □ Bar in Sq. Inches. | Area of ○ Bar in Sq. Inches. | Circumference of ○ Bar in Inches. |
|---|---|---|---|---|---|
| 4 | 54.40 | 42.73 | 16.000 | 12.566 | 12.566 |
| 1/16 | 56.11 | 44.07 | 16.504 | 12.962 | 12.763 |
| 1/8 | 57.85 | 45.44 | 17.016 | 13.364 | 12.959 |
| 3/16 | 59.62 | 46.83 | 17.535 | 13.772 | 13.155 |
| 1/4 | 61.41 | 48.24 | 18.063 | 14.186 | 13.352 |
| 5/16 | 63.23 | 49.66 | 18.598 | 14.607 | 13.548 |
| 3/8 | 65.08 | 51.11 | 19.141 | 15.033 | 13.744 |
| 7/16 | 66.95 | 52.58 | 19.691 | 15.466 | 13.941 |
| 1/2 | 68.85 | 54.07 | 20.250 | 15.904 | 14.137 |
| 9/16 | 70.78 | 55.59 | 20.816 | 16.349 | 14.334 |
| 5/8 | 72.73 | 57.12 | 21.391 | 16.800 | 14.530 |
| 11/16 | 74.70 | 58.67 | 21.973 | 17.257 | 14.726 |
| 3/4 | 76.71 | 60.25 | 22.563 | 17.721 | 14.923 |
| 13/16 | 78.74 | 61.84 | 23.160 | 18.190 | 15.119 |
| 7/8 | 80.81 | 63.46 | 23.766 | 18.665 | 15.315 |
| 15/16 | 82.89 | 65.10 | 24.379 | 19.147 | 15.512 |
| 5 | 85.00 | 66.76 | 25.000 | 19.635 | 15.708 |
| 1/16 | 87.14 | 68.44 | 25.629 | 20.129 | 15.904 |
| 1/8 | 89.30 | 70.14 | 26.266 | 20.629 | 16.101 |
| 3/16 | 91.49 | 71.86 | 26.910 | 21.135 | 16.297 |
| 1/4 | 93.72 | 73.60 | 27.563 | 21.648 | 16.493 |
| 5/16 | 95.96 | 75.37 | 28.223 | 22.166 | 16.690 |
| 3/8 | 98.23 | 77.15 | 28.891 | 22.691 | 16.886 |
| 7/16 | 100.5 | 78.95 | 29.566 | 23.221 | 17.082 |
| 1/2 | 102.8 | 80.77 | 30.250 | 23.758 | 17.279 |
| 9/16 | 105.2 | 82.62 | 30.941 | 24.301 | 17.475 |
| 5/8 | 107.6 | 84.49 | 31.641 | 24.850 | 17.671 |
| 11/16 | 110.0 | 86.38 | 32.348 | 25.406 | 17.868 |
| 3/4 | 112.4 | 88.29 | 33.063 | 25.967 | 18.064 |
| 13/16 | 114.9 | 90.22 | 33.785 | 26.535 | 18.261 |
| 7/8 | 117.4 | 92.17 | 34.516 | 27.109 | 18.457 |
| 15/16 | 119.9 | 94.14 | 35.254 | 27.688 | 18.653 |

## SQUARE AND ROUND BARS.

(CONTINUED.)

| ss ter es. | Weight of □ Bar One Foot Long. | Weight of ○ Bar One Foot Long. | Area of □ Bar in Sq. Inches. | Area of ○ Bar in Sq. Inches. | Circumference of ○ Bar in Inches. |
|---|---|---|---|---|---|
| | 122.4 | 96.14 | 36.000 | 28.274 | 18.850 |
| | 125.0 | 98.14 | 36.754 | 28.866 | 19.046 |
| | 127.6 | 100.2 | 37.516 | 29.465 | 19.242 |
| | 130.2 | 102.2 | 38.285 | 30.069 | 19.439 |
| | 132.8 | 104.3 | 39.063 | 30.680 | 19.635 |
| | 135.5 | 106.4 | 39.848 | 31.296 | 19.831 |
| | 138.2 | 108.5 | 40.641 | 31.919 | 20.028 |
| | 140.9 | 110.7 | 41.441 | 32.548 | 20.224 |
| | 143.6 | 112.8 | 42.250 | 33.183 | 20.420 |
| | 146.5 | 114.9 | 43.066 | 33.824 | 20.617 |
| | 149.2 | 117.2 | 43.891 | 34.472 | 20.813 |
| | 152.1 | 119.4 | 44.723 | 35.125 | 21.009 |
| | 154.9 | 121.7 | 45.563 | 35.785 | 21.206 |
| | 157.8 | 123.9 | 46.410 | 36.450 | 21.402 |
| | 160.8 | 126.2 | 47.266 | 37.122 | 21.598 |
| | 163.6 | 128.5 | 48.129 | 37.800 | 21.795 |
| | 166.6 | 130.9 | 49.000 | 38.485 | 21.991 |
| | 169.6 | 133.2 | 49.879 | 39.175 | 22.187 |
| | 172.6 | 135.6 | 50.766 | 39.871 | 22.384 |
| | 175.6 | 137.9 | 51.660 | 40.574 | 22.580 |
| | 178.7 | 140.4 | 52.563 | 41.282 | 22.777 |
| | 181.8 | 142.8 | 53.473 | 41.997 | 22.973 |
| | 184.9 | 145.3 | 54.391 | 42.718 | 23.169 |
| | 188.1 | 147.7 | 55.316 | 43.445 | 23.366 |
| | 191.3 | 150.2 | 56.250 | 44.179 | 23.562 |
| | 194.4 | 152.7 | 57.191 | 44.918 | 23.758 |
| | 197.7 | 155.2 | 58.141 | 45.664 | 23.955 |
| | 200.9 | 157.8 | 59.098 | 46.415 | 24.151 |
| | 204.2 | 160.3 | 60.063 | 47.173 | 24.347 |
| | 207.6 | 163.0 | 61.035 | 47.937 | 24.544 |
| | 210.8 | 165.6 | 62.016 | 48.707 | 24.740 |
| | 214.2 | 168.2 | 63.004 | 49.483 | 24.936 |

## SQUARE AND ROUND BARS.

(CONTINUED.)

| Thickness or Diameter in Inches. | Weight of □ Bar One Foot Long. | Weight of ○ Bar One Foot Long. | Area of □ Bar in Sq. Inches. | Area of ○ Bar in Sq. Inches. | Circumference of ○ Bar in Inches. |
|---|---|---|---|---|---|
| 8 | 217.6 | 171.0 | 64.000 | 50.265 | 25.133 |
| 1/16 | 221.0 | 173.6 | 65.004 | 51.054 | 25.329 |
| 1/8 | 224.5 | 176.3 | 66.016 | 51.849 | 25.525 |
| 3/16 | 228.0 | 179.0 | 67.035 | 52.649 | 25.722 |
| 1/4 | 231.4 | 181.8 | 68.063 | 53.456 | 25.918 |
| 5/16 | 234.9 | 184.5 | 69.098 | 54.269 | 26.114 |
| 3/8 | 238.5 | 187.3 | 70.141 | 55.088 | 26.311 |
| 7/16 | 242.0 | 190.1 | 71.191 | 55.914 | 26.507 |
| 1/2 | 245.6 | 193.0 | 72.250 | 56.745 | 26.704 |
| 9/16 | 249.3 | 195.7 | 73.316 | 57.583 | 26.900 |
| 5/8 | 252.9 | 198.7 | 74.391 | 58.426 | 27.096 |
| 11/16 | 256.6 | 201.6 | 75.473 | 59.276 | 27.293 |
| 3/4 | 260.3 | 204.4 | 76.563 | 60.132 | 27.489 |
| 13/16 | 264.1 | 207.4 | 77.660 | 60.994 | 27.685 |
| 7/8 | 267.9 | 210.3 | 78.766 | 61.862 | 27.882 |
| 15/16 | 271.6 | 213.3 | 79.879 | 62.737 | 28.078 |
| 9 | 275.4 | 216.3 | 81.000 | 63.617 | 28.274 |
| 1/16 | 279.3 | 219.3 | 82.129 | 64.504 | 28.471 |
| 1/8 | 283.2 | 222.4 | 83.266 | 65.397 | 28.667 |
| 3/16 | 287.0 | 225.4 | 84.410 | 66.296 | 28.863 |
| 1/4 | 290.9 | 228.5 | 85.563 | 67.201 | 29.060 |
| 5/16 | 294.9 | 231.5 | 86.723 | 68.112 | 29.256 |
| 3/8 | 298.9 | 234.7 | 87.891 | 69.029 | 29.452 |
| 7/16 | 302.8 | 237.9 | 89.066 | 69.953 | 29.649 |
| 1/2 | 306.8 | 241.0 | 90.250 | 70.882 | 29.845 |
| 9/16 | 310.9 | 244.2 | 91.441 | 71.818 | 30.041 |
| 5/8 | 315.0 | 247.4 | 92.641 | 72.760 | 30.238 |
| 11/16 | 319.1 | 250.6 | 93.848 | 73.708 | 30.434 |
| 3/4 | 323.2 | 253.9 | 95.063 | 74.662 | 30.631 |
| 13/16 | 327.4 | 257.1 | 96.285 | 75.622 | 30.827 |
| 7/8 | 331.6 | 260.4 | 97.516 | 76.589 | 31.023 |
| 15/16 | 335.8 | 263.7 | 98.754 | 77.561 | 31.220 |

## SQUARE AND ROUND BARS.

(CONTINUED.)

| Thickness or Diameter in Inches. | Weight of □ Bar One Foot Long. | Weight of ○ Bar One Foot Long. | Area of □ Bar in Sq. Inches. | Area of ○ Bar in Sq. Inches. | Circumference of ○ Bar in Inches. |
|---|---|---|---|---|---|
| 10 | 340.0 | 267.0 | 100.00 | 78.540 | 31.416 |
| 1/16 | 344.3 | 270.4 | 101.25 | 79.525 | 31.612 |
| 1/8 | 348.5 | 273.8 | 102.52 | 80.516 | 31.809 |
| 3/16 | 352.9 | 277.1 | 103.79 | 81.513 | 32.005 |
| 1/4 | 357.2 | 280.6 | 105.06 | 82.516 | 32.201 |
| 5/16 | 361.6 | 284.0 | 106.35 | 83.525 | 32.398 |
| 3/8 | 366.0 | 287.4 | 107.64 | 84.541 | 32.594 |
| 7/16 | 370.4 | 290.9 | 108.94 | 85.562 | 32.790 |
| 1/2 | 374.9 | 294.4 | 110.25 | 86.590 | 32.987 |
| 9/16 | 379.4 | 297.9 | 111.57 | 87.624 | 33.183 |
| 5/8 | 383.8 | 301.4 | 112.89 | 88.664 | 33.379 |
| 11/16 | 388.3 | 305.0 | 114.22 | 89.710 | 33.576 |
| 3/4 | 392.9 | 308.6 | 115.56 | 90.763 | 33.772 |
| 13/16 | 397.5 | 312.2 | 116.91 | 91.821 | 33.968 |
| 7/8 | 402.1 | 315.8 | 118.27 | 92.886 | 34.165 |
| 15/16 | 406.8 | 319.5 | 119.63 | 93.956 | 34.361 |
| 11 | 411.4 | 323.1 | 121.00 | 95.033 | 34.558 |
| 1/16 | 416.1 | 326.8 | 122.38 | 96.116 | 34.754 |
| 1/8 | 420.9 | 330.5 | 123.77 | 97.205 | 34.950 |
| 3/16 | 425.5 | 334.3 | 125.16 | 98.301 | 35.147 |
| 1/4 | 430.3 | 337.9 | 126.56 | 99.402 | 35.343 |
| 5/16 | 435.1 | 341.7 | 127.97 | 100.51 | 35.539 |
| 3/8 | 439.9 | 345.5 | 129.39 | 101.62 | 35.736 |
| 7/16 | 444.8 | 349.4 | 130.82 | 102.74 | 35.932 |
| 1/2 | 449.6 | 353.1 | 132.25 | 103.87 | 36.128 |
| 9/16 | 454.5 | 357.0 | 133.69 | 105.00 | 36.325 |
| 5/8 | 459.5 | 360.9 | 135.14 | 106.14 | 36.521 |
| 11/16 | 464.4 | 364.8 | 136.60 | 107.28 | 36.717 |
| 3/4 | 469.4 | 368.6 | 138.06 | 108.43 | 36.914 |
| 13/16 | 474.4 | 372.6 | 139.54 | 109.59 | 37.110 |
| 7/8 | 479.5 | 376.6 | 141.02 | 110.75 | 37.306 |
| 15/16 | 484.5 | 380.6 | 142.50 | 111.92 | 37.5 |

## AREAS OF FLAT ROLLED STEEL BARS.

For Thicknesses from $\frac{1}{16}$ in. to 2 in. and Widths from 1 in. to 12¾ in.

| Thickness in Inches. | 1″ | 1¼″ | 1½″ | 1¾″ | 2″ | 2¼″ | 2½″ | 2¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| $\frac{1}{16}$ | .063 | .078 | .094 | .109 | .125 | .141 | .156 | .172 | .750 |
| $\frac{1}{8}$ | .125 | .156 | .188 | .219 | .250 | .281 | .313 | .344 | 1.50 |
| $\frac{3}{16}$ | .188 | .234 | .281 | .328 | .375 | .422 | .469 | .516 | 2.25 |
| $\frac{1}{4}$ | .250 | .313 | .375 | .438 | .500 | .563 | .625 | .688 | 3.00 |
| $\frac{5}{16}$ | .313 | .391 | .469 | .547 | .625 | .703 | .781 | .859 | 3.75 |
| $\frac{3}{8}$ | .375 | .469 | .563 | .656 | .750 | .844 | .938 | 1.03 | 4.50 |
| $\frac{7}{16}$ | .438 | .547 | .656 | .766 | .875 | .984 | 1.09 | 1.20 | 5.25 |
| $\frac{1}{2}$ | .500 | .625 | .750 | .875 | 1.00 | 1.13 | 1.25 | 1.38 | 6.00 |
| $\frac{9}{16}$ | .563 | .703 | .844 | .984 | 1.13 | 1.27 | 1.41 | 1.55 | 6.75 |
| $\frac{5}{8}$ | .625 | .781 | .938 | 1.09 | 1.25 | 1.41 | 1.56 | 1.72 | 7.50 |
| $\frac{11}{16}$ | .688 | .859 | 1.03 | 1.20 | 1.38 | 1.55 | 1.72 | 1.89 | 8.25 |
| $\frac{3}{4}$ | .750 | .938 | 1.13 | 1.31 | 1.50 | 1.69 | 1.88 | 2.06 | 9.00 |
| $\frac{13}{16}$ | .813 | 1.02 | 1.22 | 1.42 | 1.63 | 1.83 | 2.03 | 2.23 | 9.75 |
| $\frac{7}{8}$ | .875 | 1.09 | 1.31 | 1.53 | 1.75 | 1.97 | 2.19 | 2.41 | 10.50 |
| $\frac{15}{16}$ | .938 | 1.17 | 1.41 | 1.64 | 1.88 | 2.11 | 2.34 | 2.58 | 11.25 |
| 1 | 1.00 | 1.25 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 2.75 | 12.00 |
| $1\frac{1}{16}$ | 1.06 | 1.33 | 1.59 | 1.86 | 2.13 | 2.39 | 2.66 | 2.92 | 12.75 |
| $1\frac{1}{8}$ | 1.13 | 1.41 | 1.69 | 1.97 | 2.25 | 2.53 | 2.81 | 3.09 | 13.50 |
| $1\frac{3}{16}$ | 1.19 | 1.48 | 1.78 | 2.08 | 2.38 | 2.67 | 2.97 | 3.27 | 14.25 |
| $1\frac{1}{4}$ | 1.25 | 1.56 | 1.88 | 2.19 | 2.50 | 2.81 | 3.13 | 3.44 | 15.00 |
| $1\frac{5}{16}$ | 1.31 | 1.64 | 1.97 | 2.30 | 2.63 | 2.95 | 3.28 | 3.61 | 15.75 |
| $1\frac{3}{8}$ | 1.38 | 1.72 | 2.06 | 2.41 | 2.75 | 3.09 | 3.44 | 3.78 | 16.50 |
| $1\frac{7}{16}$ | 1.44 | 1.80 | 2.16 | 2.52 | 2.88 | 3.23 | 3.59 | 3.95 | 17.25 |
| $1\frac{1}{2}$ | 1.50 | 1.88 | 2.25 | 2.63 | 3.00 | 3.38 | 3.75 | 4.13 | 18.00 |
| $1\frac{9}{16}$ | 1.56 | 1.95 | 2.34 | 2.73 | 3.13 | 3.52 | 3.91 | 4.30 | 18.75 |
| $1\frac{5}{8}$ | 1.63 | 2.03 | 2.44 | 2.84 | 3.25 | 3.66 | 4.06 | 4.47 | 19.50 |
| $1\frac{11}{16}$ | 1.69 | 2.11 | 2.53 | 2.95 | 3.38 | 3.80 | 4.22 | 4.64 | 20.25 |
| $1\frac{3}{4}$ | 1.75 | 2.19 | 2.63 | 3.06 | 3.50 | 3.94 | 4.38 | 4.81 | 21.00 |
| $1\frac{13}{16}$ | 1.81 | 2.27 | 2.72 | 3.17 | 3.63 | 4.08 | 4.53 | 4.98 | 21.75 |
| $1\frac{7}{8}$ | 1.88 | 2.34 | 2.81 | 3.28 | 3.75 | 4.22 | 4.69 | 5.16 | 22.50 |
| $1\frac{15}{16}$ | 1.94 | 2.42 | 2.91 | 3.39 | 3.88 | 4.36 | 4.84 | 5.33 | 23.25 |
| 2 | 2.00 | 2.50 | 3.00 | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 | 24.00 |

# AREAS OF FLAT ROLLED STEEL BARS.

(CONTINUED.)

| Thickness in Inches. | 3″ | 3¼″ | 3½″ | 3¾″ | 4″ | 4¼″ | 4½″ | 4¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | .188 | .203 | .219 | .234 | .250 | .266 | .281 | .297 | .750 |
| 1/8 | .375 | .406 | .438 | .469 | .500 | .531 | .563 | .594 | 1.50 |
| 3/16 | .563 | .609 | .656 | .703 | .750 | .797 | .844 | .891 | 2.25 |
| 1/4 | .750 | .813 | .875 | .938 | 1.00 | 1.06 | 1.13 | 1.19 | 3.00 |
| 5/16 | .938 | 1.02 | 1.09 | 1.17 | 1.25 | 1.33 | 1.41 | 1.48 | 3.75 |
| 3/8 | 1.13 | 1.22 | 1.31 | 1.41 | 1.50 | 1.59 | 1.69 | 1.78 | 4.50 |
| 7/16 | 1.31 | 1.42 | 1.53 | 1.64 | 1.75 | 1.86 | 1.97 | 2.08 | 5.25 |
| 1/2 | 1.50 | 1.63 | 1.75 | 1.88 | 2.00 | 2.13 | 2.25 | 2.38 | 6.00 |
| 9/16 | 1.69 | 1.83 | 1.97 | 2.11 | 2.25 | 2.39 | 2.53 | 2.67 | 6.75 |
| 5/8 | 1.88 | 2.03 | 2.19 | 2.34 | 2.50 | 2.66 | 2.81 | 2.97 | 7.50 |
| 11/16 | 2.06 | 2.23 | 2.41 | 2.58 | 2.75 | 2.92 | 3.09 | 3.27 | 8.25 |
| 3/4 | 2.25 | 2.44 | 2.63 | 2.81 | 3.00 | 3.19 | 3.38 | 3.56 | 9.00 |
| 13/16 | 2.44 | 2.64 | 2.84 | 3.05 | 3.25 | 3.45 | 3.66 | 3.86 | 9.75 |
| 7/8 | 2.63 | 2.84 | 3.06 | 3.28 | 3.50 | 3.72 | 3.94 | 4.16 | 10.50 |
| 15/16 | 2.81 | 3.05 | 3.28 | 3.52 | 3.75 | 3.98 | 4.22 | 4.45 | 11.25 |
| 1 | 3.00 | 3.25 | 3.50 | 3.75 | 4.00 | 4.25 | 4.50 | 4.75 | 12.00 |
| 1 1/16 | 3.19 | 3.45 | 3.72 | 3.98 | 4.25 | 4.52 | 4.78 | 5.05 | 12.75 |
| 1 1/8 | 3.38 | 3.66 | 3.94 | 4.22 | 4.50 | 4.78 | 5.06 | 5.34 | 13.50 |
| 1 3/16 | 3.56 | 3.86 | 4.16 | 4.45 | 4.75 | 5.05 | 5.34 | 5.64 | 14.25 |
| 1 1/4 | 3.75 | 4.06 | 4.38 | 4.69 | 5.00 | 5.31 | 5.63 | 5.94 | 15.00 |
| 1 5/16 | 3.94 | 4.27 | 4.59 | 4.92 | 5.25 | 5.58 | 5.91 | 6.23 | 15.75 |
| 1 3/8 | 4.13 | 4.47 | 4.81 | 5.16 | 5.50 | 5.84 | 6.19 | 6.53 | 16.50 |
| 1 7/16 | 4.31 | 4.67 | 5.03 | 5.39 | 5.75 | 6.11 | 6.47 | 6.83 | 17.25 |
| 1 1/2 | 4.50 | 4.88 | 5.25 | 5.63 | 6.00 | 6.38 | 6.75 | 7.13 | 18.00 |
| 1 9/16 | 4.69 | 5.08 | 5.47 | 5.86 | 6.25 | 6.64 | 7.03 | 7.42 | 18.75 |
| 1 5/8 | 4.88 | 5.28 | 5.69 | 6.09 | 6.50 | 6.91 | 7.31 | 7.72 | 19.50 |
| 1 11/16 | 5.06 | 5.48 | 5.91 | 6.33 | 6.75 | 7.17 | 7.59 | 8.02 | 20.25 |
| 1 3/4 | 5.25 | 5.69 | 6.13 | 6.56 | 7.00 | 7.44 | 7.88 | 8.31 | 21.00 |
| 1 13/16 | 5.44 | 5.89 | 6.34 | 6.80 | 7.25 | 7.70 | 8.16 | 8.61 | 21.75 |
| 1 7/8 | 5.63 | 6.09 | 6.56 | 7.03 | 7.50 | 7.97 | 8.44 | 8.91 | 22.50 |
| 1 15/16 | 5.81 | 6.30 | 6.78 | 7.27 | 7.75 | 8.23 | 8.72 | 9.20 | 23.25 |
| 2 | 6.00 | 6.50 | 7.00 | 7.50 | 8.00 | 8.50 | 9.00 | 9.50 | 24.00 |

## AREAS OF FLAT ROLLED STEEL BARS.

(CONTINUED.)

| Thickness in Inches. | 5″ | 5¼″ | 5½″ | 5¾″ | 6″ | 6¼″ | 6½″ | 6¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | .313 | .328 | .344 | .359 | .375 | .391 | .406 | .422 | .750 |
| 1/8 | .625 | .656 | .688 | .719 | .750 | .781 | .813 | .844 | 1.50 |
| 3/16 | .938 | .984 | 1.03 | 1.08 | 1.13 | 1.17 | 1.22 | 1.27 | 2.25 |
| 1/4 | 1.25 | 1.31 | 1.38 | 1.44 | 1.50 | 1.56 | 1.63 | 1.69 | 3.00 |
| 5/16 | 1.56 | 1.64 | 1.72 | 1.80 | 1.88 | 1.95 | 2.03 | 2.11 | 3.75 |
| 3/8 | 1.88 | 1.97 | 2.06 | 2.16 | 2.25 | 2.34 | 2.44 | 2.53 | 4.50 |
| 7/16 | 2.19 | 2.30 | 2.41 | 2.52 | 2.63 | 2.73 | 2.84 | 2.95 | 5.25 |
| 1/2 | 2.50 | 2.63 | 2.75 | 2.88 | 3.00 | 3.13 | 3.25 | 3.38 | 6.00 |
| 9/16 | 2.81 | 2.95 | 3.09 | 3.23 | 3.38 | 3.52 | 3.66 | 3.80 | 6.75 |
| 5/8 | 3.13 | 3.28 | 3.44 | 3.59 | 3.75 | 3.91 | 4.06 | 4.22 | 7.50 |
| 11/16 | 3.44 | 3.61 | 3.78 | 3.95 | 4.13 | 4.30 | 4.47 | 4.64 | 8.25 |
| 3/4 | 3.75 | 3.94 | 4.13 | 4.31 | 4.50 | 4.69 | 4.88 | 5.06 | 9.00 |
| 13/16 | 4.06 | 4.27 | 4.47 | 4.67 | 4.88 | 5.08 | 5.28 | 5.48 | 9.75 |
| 7/8 | 4.38 | 4.59 | 4.81 | 5.03 | 5.25 | 5.47 | 5.69 | 5.91 | 10.50 |
| 15/16 | 4.69 | 4.92 | 5.16 | 5.39 | 5.63 | 5.86 | 6.09 | 6.33 | 11.25 |
| 1 | 5.00 | 5.25 | 5.50 | 5.75 | 6.00 | 6.25 | 6.50 | 6.75 | 12.00 |
| 1 1/16 | 5.31 | 5.58 | 5.84 | 6.11 | 6.38 | 6.64 | 6.91 | 7.17 | 12.75 |
| 1 1/8 | 5.63 | 5.91 | 6.19 | 6.47 | 6.75 | 7.03 | 7.31 | 7.59 | 13.50 |
| 1 3/16 | 5.94 | 6.23 | 6.53 | 6.83 | 7.13 | 7.42 | 7.72 | 8.02 | 14.25 |
| 1 1/4 | 6.25 | 6.56 | 6.88 | 7.19 | 7.50 | 7.81 | 8.13 | 8.44 | 15.00 |
| 1 5/16 | 6.56 | 6.89 | 7.22 | 7.55 | 7.88 | 8.20 | 8.53 | 8.86 | 15.75 |
| 1 3/8 | 6.88 | 7.22 | 7.56 | 7.91 | 8.25 | 8.59 | 8.94 | 9.28 | 16.50 |
| 1 7/16 | 7.19 | 7.55 | 7.91 | 8.27 | 8.63 | 8.98 | 9.34 | 9.70 | 17.25 |
| 1 1/2 | 7.50 | 7.88 | 8.25 | 8.63 | 9.00 | 9.38 | 9.75 | 10.13 | 18.00 |
| 1 9/16 | 7.81 | 8.20 | 8.59 | 8.98 | 9.38 | 9.77 | 10.16 | 10.55 | 18.75 |
| 1 5/8 | 8.13 | 8.53 | 8.94 | 9.34 | 9.75 | 10.16 | 10.56 | 10.97 | 19.50 |
| 1 11/16 | 8.44 | 8.86 | 9.28 | 9.70 | 10.13 | 10.55 | 10.97 | 11.39 | 20.25 |
| 1 3/4 | 8.75 | 9.19 | 9.63 | 10.06 | 10.50 | 10.94 | 11.38 | 11.81 | 21.00 |
| 1 13/16 | 9.06 | 9.52 | 9.97 | 10.42 | 10.88 | 11.33 | 11.78 | 12.23 | 21.75 |
| 1 7/8 | 9.38 | 9.84 | 10.31 | 10.78 | 11.25 | 11.72 | 12.19 | 12.66 | 22.50 |
| | 9.69 | 10.17 | 10.66 | 11.14 | 11.63 | 12.11 | 12.59 | 13.08 | 23.25 |
| | 10.00 | 10.50 | 11.00 | 11.50 | 12.00 | 12.50 | 13.00 | 13.50 | 24.00 |

## AREAS OF FLAT ROLLED STEEL BARS.

(CONTINUED.)

| Thickness in Inches. | 7″ | 7¼″ | 7½″ | 7¾″ | 8″ | 8¼″ | 8½″ | 8¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | .438 | .453 | .469 | .484 | .500 | .516 | .531 | .547 | .750 |
| 1/8 | .875 | .906 | .938 | .969 | 1.00 | 1.03 | 1.06 | 1.09 | 1.50 |
| 3/16 | 1.31 | 1.36 | 1.41 | 1.45 | 1.50 | 1.55 | 1.59 | 1.64 | 2.25 |
| 1/4 | 1.75 | 1.81 | 1.88 | 1.94 | 2.00 | 2.06 | 2.13 | 2.19 | 3.00 |
| 5/16 | 2.19 | 2.27 | 2.34 | 2.42 | 2.50 | 2.58 | 2.66 | 2.73 | 3.75 |
| 3/8 | 2.63 | 2.72 | 2.81 | 2.91 | 3.00 | 3.09 | 3.19 | 3.28 | 4.50 |
| 7/16 | 3.06 | 3.17 | 3.28 | 3.39 | 3.50 | 3.61 | 3.72 | 3.83 | 5.25 |
| 1/2 | 3.50 | 3.63 | 3.75 | 3.88 | 4.00 | 4.13 | 4.25 | 4.38 | 6.00 |
| 9/16 | 3.94 | 4.08 | 4.22 | 4.36 | 4.50 | 4.64 | 4.78 | 4.92 | 6.75 |
| 5/8 | 4.38 | 4.53 | 4.69 | 4.84 | 5.00 | 5.16 | 5.31 | 5.47 | 7.50 |
| 11/16 | 4.81 | 4.98 | 5.16 | 5.33 | 5.50 | 5.67 | 5.84 | 6.02 | 8.25 |
| 3/4 | 5.25 | 5.44 | 5.63 | 5.81 | 6.00 | 6.19 | 6.38 | 6.56 | 9.00 |
| 13/16 | 5.69 | 5.89 | 6.09 | 6.30 | 6.50 | 6.70 | 6.91 | 7.11 | 9.75 |
| 7/8 | 6.13 | 6.34 | 6.56 | 6.78 | 7.00 | 7.22 | 7.44 | 7.66 | 10.50 |
| 15/16 | 6.56 | 6.80 | 7.03 | 7.27 | 7.50 | 7.73 | 7.97 | 8.20 | 11.25 |
| 1 | 7.00 | 7.25 | 7.50 | 7.75 | 8.00 | 8.25 | 8.50 | 8.75 | 12.00 |
| 1 1/16 | 7.44 | 7.70 | 7.97 | 8.23 | 8.50 | 8.77 | 9.03 | 9.30 | 12.75 |
| 1 1/8 | 7.88 | 8.16 | 8.44 | 8.72 | 9.00 | 9.28 | 9.56 | 9.84 | 13.50 |
| 1 3/16 | 8.31 | 8.61 | 8.91 | 9.20 | 9.50 | 9.80 | 10.09 | 10.39 | 14.25 |
| 1 1/4 | 8.75 | 9.06 | 9.38 | 9.69 | 10.00 | 10.31 | 10.63 | 10.94 | 15.00 |
| 1 5/16 | 9.19 | 9.52 | 9.84 | 10.17 | 10.50 | 10.83 | 11.16 | 11.48 | 15.75 |
| 1 3/8 | 9.63 | 9.97 | 10.31 | 10.66 | 11.00 | 11.34 | 11.69 | 12.03 | 16.50 |
| 1 7/16 | 10.06 | 10.42 | 10.78 | 11.14 | 11.50 | 11.86 | 12.22 | 12.58 | 17.25 |
| 1 1/2 | 10.50 | 10.88 | 11.25 | 11.63 | 12.00 | 12.38 | 12.75 | 13.13 | 18.00 |
| 1 9/16 | 10.94 | 11.33 | 11.72 | 12.11 | 12.50 | 12.89 | 13.28 | 13.67 | 18.75 |
| 1 5/8 | 11.38 | 11.78 | 12.19 | 12.59 | 13.00 | 13.41 | 13.81 | 14.22 | 19.50 |
| 1 11/16 | 11.81 | 12.23 | 12.66 | 13.08 | 13.50 | 13.92 | 14.34 | 14.77 | 20.25 |
| 1 3/4 | 12.25 | 12.69 | 13.13 | 13.56 | 14.00 | 14.44 | 14.88 | 15.31 | 21.00 |
| 1 13/16 | 12.69 | 13.14 | 13.59 | 14.05 | 14.50 | 14.95 | 15.41 | 15.86 | 21.75 |
| 1 7/8 | 13.13 | 13.59 | 14.06 | 14.53 | 15.00 | 15.47 | 15.94 | 16.41 | 22.50 |
| 1 15/16 | 13.56 | 14.05 | 14.53 | 15.02 | 15.50 | 15.98 | 16.47 | 16.95 | 23.25 |
| 2 | 14.00 | 14.50 | 15.00 | 15.50 | 16.00 | 16.50 | 17.00 | 17.50 | 24.00 |

## AREAS OF FLAT ROLLED STEEL BARS.

(CONTINUED.)

| Thickness in Inches. | 9″ | 9¼″ | 9½″ | 9¾″ | 10″ | 10¼″ | 10½″ | 10¾″ | 12 |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | .563 | .578 | .594 | .609 | .625 | .641 | .656 | .672 | .7 |
| 1/8 | 1.13 | 1.16 | 1.19 | 1.22 | 1.25 | 1.28 | 1.31 | 1.34 | 1.5 |
| 3/16 | 1.69 | 1.73 | 1.78 | 1.83 | 1.88 | 1.92 | 1.97 | 2.02 | 2.3 |
| 1/4 | 2.25 | 2.31 | 2.38 | 2.44 | 2.50 | 2.56 | 2.63 | 2.69 | 3.0 |
| 5/16 | 2.81 | 2.89 | 2.97 | 3.05 | 3.13 | 3.20 | 3.28 | 3.36 | 3.7 |
| 3/8 | 3.38 | 3.47 | 3.56 | 3.66 | 3.75 | 3.84 | 3.94 | 4.03 | 4.5 |
| 7/16 | 3.94 | 4.05 | 4.16 | 4.27 | 4.38 | 4.48 | 4.59 | 4.70 | 5.2 |
| 1/2 | 4.50 | 4.63 | 4.75 | 4.88 | 5.00 | 5.13 | 5.25 | 5.38 | 6.0 |
| 9/16 | 5.06 | 5.20 | 5.34 | 5.48 | 5.63 | 5.77 | 5.91 | 6.05 | 6.7 |
| 5/8 | 5.63 | 5.78 | 5.94 | 6.09 | 6.25 | 6.41 | 6.56 | 6.72 | 7.5 |
| 11/16 | 6.19 | 6.36 | 6.53 | 6.70 | 6.88 | 7.05 | 7.22 | 7.39 | 8.2 |
| 3/4 | 6.75 | 6.94 | 7.13 | 7.31 | 7.50 | 7.69 | 7.88 | 8.06 | 9.0 |
| 13/16 | 7.31 | 7.52 | 7.72 | 7.92 | 8.13 | 8.33 | 8.53 | 8.73 | 9.7 |
| 7/8 | 7.88 | 8.09 | 8.31 | 8.53 | 8.75 | 8.97 | 9.19 | 9.41 | 10.5 |
| 15/16 | 8.44 | 8.67 | 8.91 | 9.14 | 9.38 | 9.61 | 9.84 | 10.08 | 11.2 |
| 1 | 9.00 | 9.25 | 9.50 | 9.75 | 10.00 | 10.25 | 10.50 | 10.75 | 12.0 |
| 1 1/16 | 9.56 | 9.83 | 10.09 | 10.36 | 10.63 | 10.89 | 11.16 | 11.42 | 12.7 |
| 1 1/8 | 10.13 | 10.41 | 10.69 | 10.97 | 11.25 | 11.53 | 11.81 | 12.09 | 13.5 |
| 1 3/16 | 10.69 | 10.98 | 11.28 | 11.58 | 11.88 | 12.17 | 12.47 | 12.77 | 14.2 |
| 1 1/4 | 11.25 | 11.56 | 11.88 | 12.19 | 12.50 | 12.81 | 13.13 | 13.44 | 15.0 |
| 1 5/16 | 11.81 | 12.14 | 12.47 | 12.80 | 13.13 | 13.45 | 13.78 | 14.11 | 15.7 |
| 1 3/8 | 12.38 | 12.72 | 13.06 | 13.41 | 13.75 | 14.09 | 14.44 | 14.78 | 16.5 |
| 1 7/16 | 12.94 | 13.30 | 13.66 | 14.02 | 14.38 | 14.73 | 15.09 | 15.45 | 17.2 |
| 1 1/2 | 13.50 | 13.88 | 14.25 | 14.63 | 15.00 | 15.38 | 15.75 | 16.13 | 18.0 |
| 1 9/16 | 14.06 | 14.45 | 14.84 | 15.23 | 15.63 | 16.02 | 16.41 | 16.80 | 18.7 |
| 1 5/8 | 14.63 | 15.03 | 15.44 | 15.84 | 16.25 | 16.66 | 17.06 | 17.47 | 19.5 |
| 1 11/16 | 15.19 | 15.61 | 16.03 | 16.45 | 16.88 | 17.30 | 17.72 | 18.14 | 20.2 |
| 1 3/4 | 15.75 | 16.19 | 16.63 | 17.06 | 17.50 | 17.94 | 18.38 | 18.81 | 21.0 |
| 1 13/16 | 16.31 | 16.77 | 17.22 | 17.67 | 18.13 | 18.58 | 19.03 | 19.48 | 21.7 |
| 1 7/8 | 16.88 | 17.34 | 17.81 | 18.28 | 18.75 | 19.22 | 19.69 | 20.16 | 22.5 |
| 1 15/16 | 17.44 | 17.92 | 18.41 | 18.89 | 19.38 | 19.86 | 20.34 | 20.83 | 23.2 |
| 2 | 18.00 | 18.50 | 19.00 | 19.50 | 20.00 | 20.50 | 21.00 | 21.50 | 24.0 |

# AREAS OF FLAT ROLLED STEEL BARS.

(CONTINUED.)

| ness hes. | 11″ | 11¼″ | 11½″ | 11¾″ | 12″ | 12¼″ | 12½″ | 12¾″ |
|---|---|---|---|---|---|---|---|---|
| | .688 | .703 | .719 | .734 | .750 | .766 | .781 | .797 |
| | 1.38 | 1.41 | 1.44 | 1.47 | 1.50 | 1.53 | 1.56 | 1.59 |
| | 2.06 | 2.11 | 2.16 | 2.20 | 2.25 | 2.30 | 2.34 | 2.39 |
| | 2.75 | 2.81 | 2.88 | 2.94 | 3.00 | 3.06 | 3.13 | 3.19 |
| | 3.44 | 3.52 | 3.59 | 3.67 | 3.75 | 3.83 | 3.91 | 3.98 |
| | 4.13 | 4.22 | 4.31 | 4.41 | 4.50 | 4.59 | 4.69 | 4.78 |
| | 4.81 | 4.92 | 5.03 | 5.14 | 5.25 | 5.36 | 5.47 | 5.58 |
| | 5.50 | 5.63 | 5.75 | 5.88 | 6.00 | 6.13 | 6.25 | 6.38 |
| | 6.19 | 6.33 | 6.47 | 6.61 | 6.75 | 6.89 | 7.03 | 7.17 |
| | 6.88 | 7.03 | 7.19 | 7.34 | 7.50 | 7.66 | 7.81 | 7.97 |
| | 7.56 | 7.73 | 7.91 | 8.08 | 8.25 | 8.42 | 8.59 | 8.77 |
| | 8.25 | 8.44 | 8.63 | 8.81 | 9.00 | 9.19 | 9.38 | 9.56 |
| | 8.94 | 9.14 | 9.34 | 9.55 | 9.75 | 9.95 | 10.16 | 10.36 |
| | 9.63 | 9.84 | 10.06 | 10.28 | 10.50 | 10.72 | 10.94 | 11.16 |
| | 10.31 | 10.55 | 10.78 | 11.02 | 11.25 | 11.48 | 11.72 | 11.95 |
| | 11.00 | 11.25 | 11.50 | 11.75 | 12.00 | 12.25 | 12.50 | 12.75 |
| | 11.69 | 11.95 | 12.22 | 12.48 | 12.75 | 13.02 | 13.28 | 13.55 |
| | 12.38 | 12.66 | 12.94 | 13.22 | 13.50 | 13.78 | 14.06 | 14.34 |
| | 13.06 | 13.36 | 13.66 | 13.95 | 14.25 | 14.55 | 14.84 | 15.14 |
| | 13.75 | 14.06 | 14.38 | 14.69 | 15.00 | 15.31 | 15.63 | 15.94 |
| | 14.44 | 14.77 | 15.09 | 15.42 | 15.75 | 16.08 | 16.41 | 16.73 |
| | 15.13 | 15.47 | 15.81 | 16.16 | 16.50 | 16.84 | 17.19 | 17.53 |
| | 15.81 | 16.17 | 16.53 | 16.89 | 17.25 | 17.61 | 17.97 | 18.33 |
| | 16.50 | 16.88 | 17.25 | 17.63 | 18.00 | 18.38 | 18.75 | 19.13 |
| | 17.19 | 17.58 | 17.97 | 18.36 | 18.75 | 19.14 | 19.53 | 19.92 |
| | 17.88 | 18.28 | 18.69 | 19.09 | 19.50 | 19.91 | 20.31 | 20.72 |
| | 18.56 | 18.98 | 19.41 | 19.83 | 20.25 | 20.67 | 21.09 | 21.52 |
| | 19.25 | 19.69 | 20.13 | 20.56 | 21.00 | 21.44 | 21.88 | 22.31 |
| | 19.94 | 20.39 | 20.84 | 21.30 | 21.75 | 22.20 | 22.66 | 23.11 |
| | 20.63 | 21.09 | 21.56 | 22.03 | 22.50 | 22.97 | 23.44 | 23.91 |
| | 21.31 | 21.80 | 22.28 | 22.77 | 23.25 | 23.73 | 24.22 | 24.70 |
| | 22.00 | 22.50 | 23.00 | 23.50 | 24.00 | 24.50 | 25.00 | 25.50 |

The areas for 12″ width are repeated on each page to facilitate making the additions necessary to obtain the areas of plates of any width greater than 12″. Thus, to find the area of 15¾″ × ⅞″, add the area to be found in the same line for 3¾ × ⅞ and 12 × ⅞ = 2.84 + 10.50 = 13.34 square inches. Area of plate 4′ 6½″ × ½″ = 4 × 7.50 + 4.06 = 34.06 square inches.

# WEIGHTS OF FLAT ROLLED STRIPS, HOOP OR BAND STEEL.

## PER LINEAL FOOT.

### Thicknesses by Birmingham Wire Gauge.

One cubic foot of steel weighs 489.6 pounds.
For widths from ¼ inch to ¾ inch and thicknesses from No. 19 to No. 11 B.W.G.

| Width in Inches. | No. 19. .042 In. | No. 18. .049 In. | No. 17. .058 In. | No. 16. .065 In. | No. 15. .072 In. | No. 14. .083 In. | No. 13. .095 In. | No. 12. .109 In. | No. 11. .120 In. |
|---|---|---|---|---|---|---|---|---|---|
| 1/4 | .036 | .042 | .049 | .055 | .061 | .071 | .081 | .093 | .102 |
| 17/64 | .038 | .044 | .052 | .059 | .065 | .075 | .086 | .098 | .108 |
| 9/32 | .040 | .047 | .055 | .062 | .069 | .079 | .091 | .104 | .115 |
| 19/64 | .042 | .049 | .059 | .066 | .073 | .084 | .096 | .110 | .121 |
| 5/16 | .045 | .052 | .062 | .069 | .077 | .088 | .101 | .116 | .128 |
| 21/64 | .047 | .055 | .065 | .073 | .080 | .093 | .106 | .122 | .134 |
| 11/32 | .049 | .057 | .068 | .076 | .084 | .097 | .111 | .127 | .140 |
| 23/64 | .051 | .060 | .071 | .079 | .088 | .101 | .116 | .133 | .147 |
| 3/8 | .054 | .062 | .074 | .083 | .092 | .106 | .121 | .139 | .153 |
| 25/64 | .056 | .065 | .077 | .086 | .096 | .110 | .126 | .145 | .159 |
| 13/32 | .058 | .068 | .080 | .090 | .099 | .115 | .131 | .151 | .166 |
| 27/64 | .060 | .070 | .083 | .093 | .103 | .119 | .136 | .156 | .172 |
| 7/16 | .062 | .073 | .086 | .097 | .107 | .123 | .141 | .162 | .179 |
| 29/64 | .065 | .075 | .089 | .100 | .111 | .128 | .146 | .168 | .185 |
| 15/32 | .067 | .078 | .092 | .104 | .115 | .132 | .151 | .174 | .191 |
| 31/64 | .069 | .081 | .096 | .107 | .119 | .137 | .156 | .180 | .198 |
| 1/2 | .071 | .083 | .099 | .111 | .122 | .141 | .162 | .185 | .204 |
| 33/64 | .074 | .086 | .102 | .114 | .126 | .146 | .167 | .191 | .210 |
| 17/32 | .076 | .089 | .105 | .117 | .130 | .150 | .172 | .197 | .217 |
| 35/64 | .078 | .091 | .108 | .121 | .134 | .154 | .177 | .203 | .223 |
| 9/16 | .080 | .094 | .111 | .124 | .138 | .159 | .182 | .208 | .230 |
| 37/64 | .083 | .096 | .114 | .128 | .142 | .163 | .187 | .214 | .236 |
| 19/32 | .085 | .099 | .117 | .131 | .145 | .168 | .192 | .220 | .242 |
| 39/64 | .087 | .102 | .120 | .135 | .149 | .172 | .197 | .226 | .249 |
| 5/8 | .089 | .104 | .123 | .138 | .153 | .176 | .202 | .232 | .255 |
| 41/64 | .091 | .107 | .126 | .142 | .157 | .181 | .207 | .237 | .261 |
| 21/32 | .094 | .109 | .139 | .145 | .161 | .185 | .212 | .243 | .268 |
| 43/64 | .096 | .112 | .132 | .148 | .164 | .190 | .217 | .249 | .274 |
| 11/16 | .098 | .115 | .136 | .152 | .168 | .194 | .222 | .255 | .281 |
| 45/64 | .100 | .117 | .139 | .155 | .172 | .198 | .227 | .261 | .287 |
| 23/32 | .103 | .120 | .142 | .159 | .176 | .203 | .232 | .266 | .293 |
| 47/64 | .105 | .122 | .145 | .162 | .180 | .207 | .237 | .272 | .300 |
| 3/4 | .107 | .125 | .148 | .166 | .184 | .212 | .242 | .278 | .306 |

# WEIGHTS OF FLAT ROLLED STEEL BARS.

## PER LINEAL FOOT.

One cubic foot of steel weighs 489.6 pounds.

For thicknesses from $\frac{1}{16}$ inch to $\frac{3}{64}$ inch and widths from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch.

| Thickness in Inches. | 1/4" | 17/64" | 9/32" | 19/64" | 5/16" | 21/64" | 11/32" | 23/64" | 3/8" |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | .053 | .056 | .060 | .063 | .066 | .070 | .073 | .076 | .080 |
| 5/64 | .066 | .071 | .075 | .079 | .083 | .087 | .091 | .095 | .100 |
| 3/32 | .080 | .085 | .090 | .095 | .100 | .105 | .110 | .115 | .120 |
| 7/64 | .093 | .099 | .105 | .110 | .116 | .122 | .128 | .134 | .139 |
| 1/8 | .106 | .113 | .120 | .126 | .133 | .139 | .146 | .153 | .159 |
| 9/64 | .120 | .127 | .134 | .142 | .149 | .157 | .164 | .172 | .179 |
| 5/32 | .133 | .141 | .149 | .158 | .166 | .174 | .183 | .191 | .199 |
| 11/64 | .146 | .155 | .164 | .173 | .183 | .192 | .201 | .210 | .219 |
| 3/16 | .159 | .169 | .179 | .189 | .199 | .209 | .219 | .229 | .239 |
| 13/64 | .173 | .183 | .194 | .205 | .216 | .227 | .237 | .248 | .259 |
| 7/32 | .186 | .198 | .209 | .221 | .232 | .244 | .256 | .267 | .279 |
| 15/64 | .199 | .212 | .224 | .237 | .249 | .261 | .274 | .286 | .299 |
| 1/4 | .213 | .226 | .239 | .252 | .266 | .279 | .292 | .305 | .319 |
| 17/64 | .226 | .240 | .254 | .268 | .282 | .296 | .310 | .325 | .339 |
| 9/32 | .239 | .254 | .269 | .284 | .299 | .314 | .329 | .344 | .359 |
| 19/64 | .252 | .268 | .284 | .300 | .315 | .331 | .347 | .363 | .379 |
| 5/16 | .266 | .282 | .299 | .315 | .332 | .349 | .365 | .382 | .398 |
| 21/64 | .279 | .296 | .314 | .331 | .349 | .366 | .383 | .401 | .418 |
| 11/32 | .292 | .310 | .329 | .347 | .365 | .383 | .402 | .420 | .438 |
| 23/64 | .305 | .325 | .344 | .363 | .382 | .401 | .420 | .439 | .458 |
| 3/8 | .319 | .339 | .359 | .379 | .398 | .418 | .438 | .458 | .478 |
| 25/64 | .332 | .353 | .374 | .394 | .415 | .436 | .457 | .477 | .498 |
| 13/32 | .345 | .367 | .388 | .410 | .432 | .453 | .475 | .496 | .518 |
| 27/64 | .359 | .381 | .403 | .426 | .448 | .471 | .493 | .515 | .538 |
| 7/16 | .372 | .395 | .418 | .442 | .465 | .488 | .511 | .535 | .558 |
| 29/64 | .385 | .409 | .433 | .457 | .481 | .506 | .530 | .554 | .578 |
| 15/32 | .398 | .423 | .448 | .473 | .498 | .523 | .548 | .573 | .598 |
| 31/64 | .412 | .437 | .463 | .489 | .515 | .540 | .566 | .592 | .618 |
| 1/2 | .425 | .452 | .478 | .505 | .531 | .558 | .584 | .611 | .638 |
| 33/64 | .438 | .466 | .493 | .520 | .548 | .575 | .603 | .630 | .657 |
| 17/32 | .452 | .480 | .508 | .536 | .564 | .593 | .621 | .649 | .677 |
| 35/64 | .465 | .494 | .523 | .552 | .581 | .610 | .639 | .668 | .697 |
| 9/16 | .478 | .508 | .538 | .567 | .598 | .628 | .657 | .687 | .717 |

# WEIGHTS OF FLAT ROLLED STEEL BAI

## PER LINEAL FOOT.

(CONTINUED.)

| Thickness in Inches. | 25/64" | 13/32" | 27/64" | 7/16" | 29/64" | 15/32" | 31/64" | 1/2" |
|---|---|---|---|---|---|---|---|---|
| 1/16 | .083 | .086 | .090 | .093 | .096 | .100 | .103 | .106 |
| 5/64 | .104 | .108 | .112 | .116 | .120 | .125 | .129 | .133 |
| 3/32 | .125 | .129 | .134 | .139 | .144 | .149 | .154 | .159 |
| 7/64 | .145 | .151 | .157 | .163 | .169 | .174 | .180 | .186 |
| 1/8 | .166 | .173 | .179 | .186 | .193 | .199 | .206 | .212 |
| 9/64 | .187 | .194 | .202 | .209 | .217 | .224 | .232 | .239 |
| 5/32 | .208 | .216 | .224 | .232 | .241 | .249 | .257 | .266 |
| 11/64 | .228 | .237 | .247 | .256 | .265 | .274 | .283 | .292 |
| 3/16 | .249 | .259 | .269 | .279 | .289 | .299 | .309 | .319 |
| 13/64 | .270 | .281 | .291 | .302 | .313 | .324 | .335 | .345 |
| 7/32 | .291 | .302 | .314 | .325 | .337 | .349 | .360 | .372 |
| 15/64 | .311 | .324 | .336 | .349 | .361 | .374 | .386 | .398 |
| 1/4 | .332 | .345 | .359 | .372 | .385 | .398 | .412 | .425 |
| 17/64 | .353 | .367 | .381 | .395 | .409 | .423 | .437 | .452 |
| 9/32 | .374 | .388 | .403 | .418 | .433 | .448 | .463 | .478 |
| 19/64 | .394 | .410 | .426 | .442 | .457 | .473 | .489 | .505 |
| 5/16 | .415 | .432 | .448 | .465 | .481 | .498 | .515 | .531 |
| 21/64 | .436 | .453 | .471 | .488 | .506 | .523 | .540 | .558 |
| 11/32 | .457 | .475 | .493 | .511 | .530 | .548 | .566 | .584 |
| 23/64 | .477 | .496 | .515 | .535 | .554 | .573 | .592 | .611 |
| 3/8 | .498 | .518 | .538 | .558 | .578 | .598 | .618 | .638 |
| 25/64 | .519 | .540 | .560 | .581 | .602 | .623 | .643 | .664 |
| 13/32 | .540 | .561 | .583 | .604 | .626 | .647 | .669 | .691 |
| 27/64 | .560 | .583 | .605 | .628 | .650 | .672 | .695 | .717 |
| 7/16 | .581 | .604 | .628 | .651 | .674 | .697 | .721 | .744 |
| 29/64 | .602 | .626 | .650 | .674 | .698 | .722 | .746 | .770 |
| 15/32 | .623 | .647 | .672 | .697 | .722 | .747 | .772 | .797 |
| 31/64 | .643 | .669 | .695 | .721 | .746 | .772 | .798 | .823 |
| 1/2 | .664 | .691 | .717 | .744 | .770 | .797 | .823 | .850 |
| 33/64 | .685 | .712 | .740 | .767 | .794 | .822 | .849 | .877 |
| 17/32 | .706 | .734 | .762 | .790 | .818 | .847 | .875 | .903 |
| 35/64 | .726 | .755 | .784 | .813 | .843 | .872 | .901 | .930 |
| 9/16 | .747 | .777 | .807 | .837 | .867 | .896 | .926 | .956 |

# WEIGHTS OF FLAT ROLLED STEEL BARS.

## PER LINEAL FOOT.

(CONTINUED.)

| Thickness in Inches. | 11/64" | 17/32" | 35/64" | 9/16" | 37/64" | 19/32" | 39/64" | 5/8" | 12" |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | .110 | .113 | .116 | .120 | .123 | .126 | .129 | .133 | 2.53 |
| 5/64 | .137 | .141 | .145 | .149 | .154 | .158 | .162 | .166 | 3.19 |
| 3/32 | .164 | .169 | .174 | .179 | .184 | .189 | .194 | .199 | 3.83 |
| 7/64 | .192 | .198 | .203 | .209 | .215 | .221 | .227 | .232 | 4.46 |
| 1/8 | .219 | .226 | .232 | .239 | .246 | .252 | .259 | .266 | 5.10 |
| 9/64 | .247 | .254 | .261 | .269 | .276 | .284 | .291 | .299 | 5.74 |
| 5/32 | .274 | .282 | .291 | .299 | .307 | .315 | .324 | .332 | 6.38 |
| 11/64 | .301 | .310 | .320 | .329 | .338 | .347 | .356 | .365 | 7.01 |
| 3/16 | .329 | .339 | .349 | .359 | .369 | .379 | .388 | .398 | 7.65 |
| 13/64 | .356 | .367 | .378 | .388 | .399 | .410 | .421 | .432 | 8.29 |
| 7/32 | .383 | .395 | .407 | .418 | .430 | .442 | .453 | .465 | 8.93 |
| 15/64 | .411 | .423 | .436 | .448 | .461 | .473 | .486 | .498 | 9.56 |
| 1/4 | .438 | .452 | .465 | .478 | .491 | .505 | .518 | .531 | 10.20 |
| 17/64 | .466 | .480 | .494 | .508 | .522 | .536 | .550 | .564 | 10.84 |
| 9/32 | .493 | .508 | .523 | .538 | .553 | .568 | .583 | .598 | 11.48 |
| 19/64 | .520 | .536 | .552 | .568 | .584 | .599 | .615 | .631 | 12.11 |
| 5/16 | .548 | .564 | .581 | .598 | .614 | .631 | .647 | .664 | 12.75 |
| 21/64 | .575 | .593 | .610 | .628 | .645 | .662 | .680 | .697 | 13.39 |
| 11/32 | .603 | .621 | .639 | .657 | .676 | .694 | .712 | .730 | 14.03 |
| 23/64 | .630 | .649 | .668 | .687 | .706 | .725 | .745 | .764 | 14.66 |
| 3/8 | .657 | .677 | .697 | .717 | .737 | .757 | .777 | .797 | 15.30 |
| 25/64 | .685 | .706 | .726 | .747 | .768 | .789 | .809 | .830 | 15.94 |
| 13/32 | .712 | .734 | .755 | .777 | .799 | .820 | .842 | .863 | 16.58 |
| 27/64 | .740 | .762 | .784 | .807 | .829 | .852 | .874 | .896 | 17.21 |
| 7/16 | .767 | .790 | .813 | .837 | .860 | .883 | .906 | .930 | 17.85 |
| 29/64 | .794 | .818 | .843 | .867 | .891 | .915 | .939 | .963 | 18.49 |
| 15/32 | .822 | .847 | .872 | .896 | .921 | .946 | .971 | .996 | 19.13 |
| 31/64 | .849 | .875 | .901 | .926 | .952 | .978 | 1.00 | 1.03 | 19.76 |
| 1/2 | .877 | .903 | .930 | .956 | .983 | 1.01 | 1.04 | 1.06 | 20.40 |
| 33/64 | .904 | .931 | .959 | .986 | 1.01 | 1.04 | 1.07 | 1.10 | 21.04 |
| 17/32 | .931 | .960 | .988 | 1.02 | 1.04 | 1.07 | 1.10 | 1.13 | 21.68 |
| 35/64 | .959 | .988 | 1.02 | 1.05 | 1.07 | 1.10 | 1.13 | 1.16 | 22.31 |
| 9/16 | .986 | 1.02 | 1.05 | 1.08 | 1.11 | 1.14 | 1.17 | 1.20 | |

# WEIGHTS OF FLAT ROLLED STEEL BARS.

## PER LINEAL FOOT.

(CONTINUED.)

| Thickness in Inches. | 41/64" | 21/32" | 43/64" | 11/16" | 45/64" | 23/32" | 47/64" | 3/4" | 1 |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | .136 | .139 | .143 | .146 | .149 | .153 | .156 | .159 | 2 |
| 2/64 | .170 | .174 | .178 | .183 | .187 | .191 | .195 | .199 | 3 |
| 3/32 | .204 | .209 | .214 | .219 | .224 | .229 | .234 | .239 | 3 |
| 7/64 | .238 | .244 | .250 | .256 | .261 | .267 | .273 | .279 | 4 |
| 1/8 | .272 | .279 | .286 | .292 | .299 | .305 | .312 | .319 | 5 |
| 9/64 | .306 | .314 | .321 | .329 | .336 | .344 | .351 | .359 | 5 |
| 5/32 | .340 | .349 | .357 | .365 | .374 | .382 | .390 | .398 | 6 |
| 11/64 | .374 | .383 | .393 | .402 | .411 | .420 | .429 | .438 | 7 |
| 3/16 | .408 | .418 | .428 | .438 | .448 | .458 | .468 | .478 | 7 |
| 13/64 | .442 | .453 | .464 | .475 | .486 | .496 | .507 | .518 | 8 |
| 7/32 | .476 | .488 | .500 | .511 | .523 | .535 | .546 | .558 | 8 |
| 15/64 | .510 | .523 | .535 | .548 | .560 | .573 | .585 | .598 | 9 |
| 1/4 | .545 | .558 | .571 | .584 | .598 | .611 | .624 | .638 | 10 |
| 17/64 | .578 | .593 | .607 | .621 | .635 | .649 | .663 | .677 | 10 |
| 9/32 | .613 | .628 | .642 | .657 | .672 | .687 | .702 | .717 | 11 |
| 19/64 | .647 | .662 | .678 | .694 | .710 | .725 | .741 | .757 | 12 |
| 5/16 | .681 | .697 | .714 | .730 | .747 | .764 | .780 | .797 | 12 |
| 21/64 | .715 | .732 | .750 | .767 | .784 | .802 | .819 | .827 | 13 |
| 11/32 | .749 | .767 | .785 | .804 | .822 | .840 | .858 | .877 | 14 |
| 23/64 | .783 | .802 | .821 | .840 | .859 | .878 | .897 | .916 | 14 |
| 3/8 | .817 | .837 | .857 | .877 | .896 | .916 | .936 | .956 | 15 |
| 25/64 | .851 | .872 | .892 | .913 | .934 | .955 | .975 | .996 | 15 |
| 13/32 | .885 | .906 | .928 | .950 | .971 | .993 | 1.01 | 1.04 | 16 |
| 27/64 | .919 | .941 | .964 | .986 | 1.01 | 1.03 | 1.05 | 1.08 | 17 |
| 7/16 | .953 | .976 | .999 | 1.02 | 1.05 | 1.07 | 1.09 | 1.12 | 17 |
| 29/64 | .987 | 1.01 | 1.04 | 1.06 | 1.08 | 1.11 | 1.13 | 1.16 | 18 |
| 15/32 | 1.02 | 1.05 | 1.07 | 1.10 | 1.12 | 1.15 | 1.17 | 1.20 | 19 |
| 31/64 | 1.06 | 1.08 | 1.11 | 1.13 | 1.16 | 1.18 | 1.21 | 1.24 | 19 |
| 1/2 | 1.09 | 1.12 | 1.14 | 1.17 | 1.20 | 1.22 | 1.25 | 1.28 | 20 |
| 33/64 | 1.12 | 1.15 | 1.18 | 1.21 | 1.23 | 1.26 | 1.29 | 1.31 | 21 |
| | 1.16 | 1.19 | 1.21 | 1.24 | 1.27 | 1.30 | 1.33 | 1.35 | 21 |
| | 1.19 | 1.22 | 1.25 | 1.28 | 1.31 | 1.34 | 1.37 | 1.39 | 22 |
| | 1.23 | 1.26 | 1.28 | 1.31 | 1.34 | 1.37 | 1.40 | 1.43 | 2 |

# WEIGHTS OF FLAT ROLLED STEEL BARS.

## PER LINEAL FOOT.

One cubic foot of steel weighs 489.6 pounds.
For Thicknesses from $\frac{3}{16}$ in. to 2 in. and Widths from 1 in. to 12¾ in.

| Thickness in Inches. | 1″ | 1¼″ | 1½″ | 1¾″ | 2″ | 2¼″ | 2½″ | 2¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| $\frac{3}{16}$ | .638 | .797 | .957 | 1.11 | 1.28 | 1.44 | 1.59 | 1.75 | 7.65 |
| $\frac{1}{4}$ | .850 | 1.06 | 1.28 | 1.49 | 1.70 | 1.91 | 2.12 | 2.34 | 10.20 |
| $\frac{5}{16}$ | 1.06 | 1.33 | 1.59 | 1.86 | 2.12 | 2.39 | 2.65 | 2.92 | 12.75 |
| $\frac{3}{8}$ | 1.28 | 1.59 | 1.92 | 2.23 | 2.55 | 2.87 | 3.19 | 3.51 | 15.30 |
| $\frac{7}{16}$ | 1.49 | 1.86 | 2.23 | 2.60 | 2.98 | 3.35 | 3.72 | 4.09 | 17.85 |
| $\frac{1}{2}$ | 1.70 | 2.12 | 2.55 | 2.98 | 3.40 | 3.83 | 4.25 | 4.67 | 20.40 |
| $\frac{9}{16}$ | 1.92 | 2.39 | 2.87 | 3.35 | 3.83 | 4.30 | 4.78 | 5.26 | 22.95 |
| $\frac{5}{8}$ | 2.12 | 2.65 | 3.19 | 3.72 | 4.25 | 4.78 | 5.31 | 5.84 | 25.50 |
| $\frac{11}{16}$ | 2.34 | 2.92 | 3.51 | 4.09 | 4.67 | 5.26 | 5.84 | 6.43 | 28.05 |
| $\frac{3}{4}$ | 2.55 | 3.19 | 3.83 | 4.47 | 5.10 | 5.75 | 6.38 | 7.02 | 30.60 |
| $\frac{13}{16}$ | 2.76 | 3.45 | 4.14 | 4.84 | 5.53 | 6.21 | 6.90 | 7.60 | 33.15 |
| $\frac{7}{8}$ | 2.98 | 3.72 | 4.47 | 5.20 | 5.95 | 6.69 | 7.44 | 8.18 | 35.70 |
| $\frac{15}{16}$ | 3.19 | 3.99 | 4.78 | 5.58 | 6.38 | 7.18 | 7.97 | 8.77 | 38.25 |
| 1 | 3.40 | 4.25 | 5.10 | 5.95 | 6.80 | 7.65 | 8.50 | 9.35 | 40.80 |
| $1\frac{1}{16}$ | 3.61 | 4.52 | 5.42 | 6.32 | 7.22 | 8.13 | 9.03 | 9.93 | 43.35 |
| $1\frac{1}{8}$ | 3.83 | 4.78 | 5.74 | 6.70 | 7.65 | 8.61 | 9.57 | 10.52 | 45.90 |
| $1\frac{3}{16}$ | 4.04 | 5.05 | 6.06 | 7.07 | 8.08 | 9.09 | 10.10 | 11.11 | 48.45 |
| $1\frac{1}{4}$ | 4.25 | 5.31 | 6.38 | 7.44 | 8.50 | 9.57 | 10.63 | 11.69 | 51.00 |
| $1\frac{5}{16}$ | 4.46 | 5.58 | 6.69 | 7.81 | 8.93 | 10.04 | 11.16 | 12.27 | 53.55 |
| $1\frac{3}{8}$ | 4.67 | 5.84 | 7.02 | 8.18 | 9.35 | 10.52 | 11.69 | 12.85 | 56.10 |
| $1\frac{7}{16}$ | 4.89 | 6.11 | 7.34 | 8.56 | 9.78 | 11.00 | 12.22 | 13.44 | 58.65 |
| $1\frac{1}{2}$ | 5.10 | 6.38 | 7.65 | 8.93 | 10.20 | 11.48 | 12.75 | 14.03 | 61.20 |
| $1\frac{9}{16}$ | 5.32 | 6.64 | 7.97 | 9.30 | 10.63 | 11.95 | 13.28 | 14.61 | 63.75 |
| $1\frac{5}{8}$ | 5.52 | 6.90 | 8.29 | 9.67 | 11.05 | 12.43 | 13.81 | 15.19 | 66.30 |
| $1\frac{11}{16}$ | 5.74 | 7.17 | 8.61 | 10.04 | 11.47 | 12.91 | 14.34 | 15.78 | 68.85 |
| $1\frac{3}{4}$ | 5.95 | 7.44 | 8.93 | 10.42 | 11.90 | 13.40 | 14.88 | 16.37 | 71.40 |
| $1\frac{13}{16}$ | 6.16 | 7.70 | 9.24 | 10.79 | 12.33 | 13.86 | 15.40 | 16.95 | 73.95 |
| $1\frac{7}{8}$ | 6.38 | 7.97 | 9.57 | 11.15 | 12.75 | 14.34 | 15.94 | 17.53 | 76.50 |
| $1\frac{15}{16}$ | 6.59 | 8.24 | 9.88 | 11.53 | 13.18 | 14.83 | 16.47 | 18.12 | 79.05 |
| 2 | 6.80 | 8.50 | 10.20 | 11.90 | 13.60 | 15.30 | 17.00 | 18.70 | |

# WEIGHTS OF FLAT ROLLED STEEL BARS.

## PER LINEAL FOOT.

(CONTINUED)

| Thickness in Inches. | 3″ | 3¼″ | 3½″ | 3¾″ | 4″ | 4¼″ | 4½″ | 4¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| 3/16 | 1.91 | 2.07 | 2.23 | 2.39 | 2.55 | 2.71 | 2.87 | 3.03 | 7.65 |
| 1/4 | 2.55 | 2.76 | 2.98 | 3.19 | 3.40 | 3.61 | 3.83 | 4.04 | 10.20 |
| 5/16 | 3.19 | 3.45 | 3.72 | 3.99 | 4.25 | 4.52 | 4.78 | 5.05 | 12.75 |
| 3/8 | 3.83 | 4.15 | 4.47 | 4.78 | 5.10 | 5.42 | 5.74 | 6.06 | 15.30 |
| 7/16 | 4.46 | 4.83 | 5.20 | 5.58 | 5.95 | 6.32 | 6.70 | 7.07 | 17.85 |
| 1/2 | 5.10 | 5.53 | 5.95 | 6.38 | 6.80 | 7.22 | 7.65 | 8.08 | 20.40 |
| 9/16 | 5.74 | 6.22 | 6.70 | 7.17 | 7.65 | 8.13 | 8.61 | 9.09 | 22.95 |
| 5/8 | 6.38 | 6.91 | 7.44 | 7.97 | 8.50 | 9.03 | 9.57 | 10.10 | 25.50 |
| 11/16 | 7.02 | 7.60 | 8.18 | 8.76 | 9.35 | 9.93 | 10.52 | 11.11 | 28.05 |
| 3/4 | 7.65 | 8.29 | 8.93 | 9.57 | 10.20 | 10.84 | 11.48 | 12.12 | 30.60 |
| 13/16 | 8.29 | 8.98 | 9.67 | 10.36 | 11.05 | 11.74 | 12.43 | 13.12 | 33.15 |
| 7/8 | 8.93 | 9.67 | 10.41 | 11.16 | 11.90 | 12.65 | 13.39 | 14.13 | 35.70 |
| 15/16 | 9.57 | 10.36 | 11.16 | 11.95 | 12.75 | 13.55 | 14.34 | 15.14 | 38.25 |
| 1 | 10.20 | 11.05 | 11.90 | 12.75 | 13.60 | 14.45 | 15.30 | 16.15 | 40.80 |
| 1 1/16 | 10.84 | 11.74 | 12.65 | 13.55 | 14.45 | 15.35 | 16.26 | 17.16 | 43.35 |
| 1 1/8 | 11.48 | 12.43 | 13.39 | 14.34 | 15.30 | 16.26 | 17.22 | 18.17 | 45.90 |
| 1 3/16 | 12.12 | 13.12 | 14.13 | 15.14 | 16.15 | 17.16 | 18.17 | 19.18 | 48.45 |
| 1 1/4 | 12.75 | 13.81 | 14.87 | 15.94 | 17.00 | 18.06 | 19.13 | 20.19 | 51.00 |
| 1 5/16 | 13.39 | 14.50 | 15.62 | 16.74 | 17.85 | 18.96 | 20.08 | 21.20 | 53.55 |
| 1 3/8 | 14.03 | 15.20 | 16.36 | 17.53 | 18.70 | 19.87 | 21.04 | 22.21 | 56.10 |
| 1 7/16 | 14.66 | 15.88 | 17.10 | 18.33 | 19.55 | 20.77 | 21.99 | 23.22 | 58.65 |
| 1 1/2 | 15.30 | 16.58 | 17.85 | 19.13 | 20.40 | 21.68 | 22.95 | 24.23 | 61.20 |
| 1 9/16 | 15.94 | 17.27 | 18.60 | 19.92 | 21.25 | 22.58 | 23.91 | 25.24 | 63.75 |
| 1 5/8 | 16.58 | 17.96 | 19.34 | 20.72 | 22.10 | 23.48 | 24.87 | 26.25 | 66.30 |
| 1 11/16 | 17.22 | 18.65 | 20.08 | 21.51 | 22.95 | 24.38 | 25.82 | 27.26 | 68.85 |
| 1 3/4 | 17.85 | 19.34 | 20.83 | 22.32 | 23.80 | 25.29 | 26.78 | 28.27 | 71.40 |
| 1 13/16 | 18.49 | 20.03 | 21.57 | 23.11 | 24.65 | 26.19 | 27.73 | 29.27 | 73.95 |
| 1 7/8 | 19.13 | 20.72 | 22.31 | 23.91 | 25.50 | 27.10 | 28.69 | 30.28 | 76.50 |
| 1 15/16 | 19.77 | 21.41 | 23.06 | 24.70 | 26.35 | 28.00 | 29.64 | 31.29 | 79.05 |
| 2 | 20.40 | 22.10 | 23.80 | 25.50 | 27.20 | 28.90 | 30.60 | 32.30 | 81.60 |

# WEIGHTS OF FLAT ROLLED STEEL BARS.

## PER LINEAL FOOT.

(CONTINUED.)

| Thickness in Inches. | 5″ | 5¼″ | 5½″ | 5¾″ | 6″ | 6¼″ | 6½″ | 6¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| 3/16 | 3.19 | 3.35 | 3.51 | 3.67 | 3.83 | 3.99 | 4.14 | 4.30 | 7.65 |
| 1/4 | 4.25 | 4.46 | 4.67 | 4.89 | 5.10 | 5.31 | 5.53 | 5.74 | 10.20 |
| 5/16 | 5.31 | 5.58 | 5.84 | 6.11 | 6.38 | 6.64 | 6.90 | 7.17 | 12.75 |
| 3/8 | 6.38 | 6.69 | 7.02 | 7.34 | 7.65 | 7.97 | 8.29 | 8.61 | 15.30 |
| 7/16 | 7.44 | 7.81 | 8.18 | 8.56 | 8.93 | 9.29 | 9.67 | 10.04 | 17.85 |
| 1/2 | 8.50 | 8.93 | 9.35 | 9.77 | 10.20 | 10.63 | 11.05 | 11.48 | 20.40 |
| 9/16 | 9.57 | 10.04 | 10.52 | 11.00 | 11.48 | 11.95 | 12.43 | 12.91 | 22.95 |
| 5/8 | 10.63 | 11.16 | 11.69 | 12.22 | 12.75 | 13.28 | 13.81 | 14.34 | 25.50 |
| 11/16 | 11.69 | 12.27 | 12.85 | 13.44 | 14.03 | 14.61 | 15.20 | 15.78 | 28.05 |
| 3/4 | 12.75 | 13.39 | 14.03 | 14.67 | 15.30 | 15.94 | 16.58 | 17.22 | 30.60 |
| 13/16 | 13.81 | 14.50 | 15.19 | 15.88 | 16.58 | 17.27 | 17.95 | 18.65 | 33.15 |
| 7/8 | 14.87 | 15.62 | 16.36 | 17.10 | 17.85 | 18.60 | 19.34 | 20.08 | 35.70 |
| 15/16 | 15.94 | 16.74 | 17.53 | 18.33 | 19.13 | 19.92 | 20.72 | 21.51 | 38.25 |
| 1 | 17.00 | 17.85 | 18.70 | 19.55 | 20.40 | 21.25 | 22.10 | 22.95 | 40.80 |
| 1 1/16 | 18.06 | 18.96 | 19.87 | 20.77 | 21.68 | 22.58 | 23.48 | 24.39 | 43.35 |
| 1 1/8 | 19.13 | 20.08 | 21.04 | 21.99 | 22.95 | 23.91 | 24.87 | 25.82 | 45.90 |
| 1 3/16 | 20.19 | 21.20 | 22.21 | 23.22 | 24.23 | 25.23 | 26.24 | 27.25 | 48.45 |
| 1 1/4 | 21.25 | 22.32 | 23.38 | 24.44 | 25.50 | 26.56 | 27.62 | 28.69 | 51.00 |
| 1 5/16 | 22.32 | 23.43 | 24.54 | 25.66 | 26.78 | 27.90 | 29.01 | 30.12 | 53.55 |
| 1 3/8 | 23.38 | 24.54 | 25.71 | 26.88 | 28.05 | 29.22 | 30.39 | 31.56 | 56.10 |
| 1 7/16 | 24.44 | 25.66 | 26.88 | 28.10 | 29.33 | 30.55 | 31.77 | 32.99 | 58.65 |
| 1 1/2 | 25.50 | 26.78 | 28.05 | 29.33 | 30.60 | 31.88 | 33.15 | 34.43 | 61.20 |
| 1 9/16 | 26.57 | 27.89 | 29.22 | 30.55 | 31.88 | 33.20 | 34.53 | 35.86 | 63.75 |
| 1 5/8 | 27.63 | 29.01 | 30.39 | 31.77 | 33.15 | 34.53 | 35.91 | 37.29 | 66.30 |
| 1 11/16 | 28.69 | 30.12 | 31.55 | 32.99 | 34.43 | 35.86 | 37.30 | 38.73 | 68.85 |
| 1 3/4 | 29.75 | 31.24 | 32.73 | 34.22 | 35.70 | 37.19 | 38.68 | 40.17 | 71.40 |
| 1 13/16 | 30.81 | 32.35 | 33.89 | 35.43 | 36.98 | 38.52 | 40.05 | 41.60 | 73.95 |
| 1 7/8 | 31.87 | 33.47 | 35.06 | 36.65 | 38.25 | 39.85 | 41.44 | 43.03 | 76.50 |
| 1 15/16 | 32.94 | 34.59 | 36.23 | 37.88 | 39.53 | 41.17 | 42.82 | 44.46 | 79.05 |
| 2 | 34.00 | 35.70 | 37.40 | 39.10 | 40.80 | 42.50 | 44.20 | 45.90 | 81.60 |

## WEIGHTS OF FLAT ROLLED STEEL BAR

### PER LINEAL FOOT.

(CONTINUED.)

| Thickness in Inches. | 7″ | 7¼″ | 7½″ | 7¾″ | 8″ | 8¼″ | 8½″ | 8¾″ |
|---|---|---|---|---|---|---|---|---|
| 1/16 | 4.46 | 4.62 | 4.78 | 4.94 | 5.10 | 5.26 | 5.42 | 5.58 |
| 1/8 | 5.95 | 6.16 | 6.36 | 6.58 | 6.80 | 7.01 | 7.22 | 7.43 |
| 3/16 | 7.44 | 7.70 | 7.97 | 8.23 | 8.50 | 8.76 | 9.03 | 9.29 |
| 1/4 | 8.93 | 9.25 | 9.57 | 9.88 | 10.20 | 10.52 | 10.84 | 11.16 |
| 5/16 | 10.41 | 10.78 | 11.16 | 11.53 | 11.90 | 12.27 | 12.64 | 13.02 |
| 3/8 | 11.90 | 12.32 | 12.75 | 13.18 | 13.60 | 14.03 | 14.44 | 14.87 |
| 7/16 | 13.39 | 13.86 | 14.34 | 14.82 | 15.30 | 15.78 | 16.26 | 16.74 |
| 1/2 | 14.87 | 15.40 | 15.94 | 16.47 | 17.00 | 17.53 | 18.06 | 18.59 |
| 9/16 | 16.36 | 16.94 | 17.53 | 18.12 | 18.70 | 19.28 | 19.86 | 20.45 |
| 5/8 | 17.85 | 18.49 | 19.13 | 19.77 | 20.40 | 21.04 | 21.68 | 22.32 |
| 11/16 | 19.34 | 20.03 | 20.72 | 21.41 | 22.10 | 22.79 | 23.48 | 24.17 |
| 3/4 | 20.83 | 21.57 | 22.32 | 23.05 | 23.80 | 24.55 | 25.30 | 26.04 |
| 13/16 | 22.32 | 23.11 | 23.91 | 24.70 | 25.50 | 26.30 | 27.10 | 27.89 |
| 1 | 23.80 | 24.65 | 25.50 | 26.35 | 27.20 | 28.05 | 28.90 | 29.75 |
| 1 1/16 | 25.29 | 26.19 | 27.10 | 28.00 | 28.90 | 29.80 | 30.70 | 31.61 |
| 1 1/8 | 26.78 | 27.73 | 28.68 | 29.64 | 30.60 | 31.56 | 32.52 | 33.47 |
| 1 3/16 | 28.26 | 29.27 | 30.28 | 31.29 | 32.30 | 33.31 | 34.32 | 35.33 |
| 1 1/4 | 29.75 | 30.81 | 31.88 | 32.94 | 34.00 | 35.06 | 36.12 | 37.20 |
| 1 5/16 | 31.23 | 32.35 | 33.48 | 34.59 | 35.70 | 36.81 | 37.93 | 39.05 |
| 1 3/8 | 32.72 | 33.89 | 35.06 | 36.23 | 37.40 | 38.57 | 39.74 | 40.91 |
| 1 7/16 | 34.21 | 35.44 | 36.66 | 37.88 | 39.10 | 40.32 | 41.54 | 42.77 |
| 1 1/2 | 35.70 | 36.98 | 38.26 | 39.53 | 40.80 | 42.08 | 43.35 | 44.63 |
| 1 9/16 | 37.19 | 38.51 | 39.84 | 41.17 | 42.50 | 43.83 | 45.16 | 46.49 |
| 1 5/8 | 38.67 | 40.05 | 41.44 | 42.82 | 44.20 | 45.58 | 46.96 | 48.34 |
| 1 11/16 | 40.16 | 41.59 | 43.03 | 44.47 | 45.90 | 47.33 | 48.76 | 50.20 |
| 1 3/4 | 41.65 | 43.14 | 44.63 | 46.12 | 47.60 | 49.09 | 50.58 | 52.07 |
| 1 13/16 | 43.14 | 44.68 | 46.22 | 47.76 | 49.30 | 50.84 | 52.38 | 53.92 |
| 1 7/8 | 44.63 | 46.22 | 47.82 | 49.40 | 51.00 | 52.60 | 54.20 | 55.79 |
| 1 15/16 | 46.12 | 47.76 | 49.41 | 51.05 | 52.70 | 54.35 | 56.00 | 57.64 |
| 2 | 47.60 | 49.30 | 51.00 | 52.70 | 54.40 | 56.10 | 57.80 | 59.50 |

# WEIGHTS OF FLAT ROLLED STEEL BARS.

## PER LINEAL FOOT.

(CONTINUED.)

| Thickness in Inches. | 9″ | 9¼″ | 9½″ | 9¾″ | 10″ | 10¼″ | 10½″ | 10¾″ | 12″ |
|---|---|---|---|---|---|---|---|---|---|
| 1/16 | 5.74 | 5.90 | 6.06 | 6.22 | 6.38 | 6.54 | 6.70 | 6.86 | 7.65 |
| 1/8 | 7.65 | 7.86 | 8.08 | 8.29 | 8.50 | 8.71 | 8.92 | 9.14 | 10.20 |
| 3/16 | 9.56 | 9.83 | 10.10 | 10.36 | 10.62 | 10.89 | 11.16 | 11.42 | 12.75 |
| 1/4 | 11.48 | 11.80 | 12.12 | 12.44 | 12.75 | 13.07 | 13.39 | 13.71 | 15.30 |
| 5/16 | 13.40 | 13.76 | 14.14 | 14.51 | 14.88 | 15.25 | 15.62 | 15.99 | 17.85 |
| 3/8 | 15.30 | 15.73 | 16.16 | 16.58 | 17.00 | 17.42 | 17.85 | 18.28 | 20.40 |
| 7/16 | 17.22 | 17.69 | 18.18 | 18.65 | 19.14 | 19.61 | 20.08 | 20.56 | 22.95 |
| 1/2 | 19.13 | 19.65 | 20.19 | 20.72 | 21.25 | 21.78 | 22.32 | 22.85 | 25.50 |
| 9/16 | 21.04 | 21.62 | 22.21 | 22.79 | 23.38 | 23.96 | 24.54 | 25.13 | 28.05 |
| 5/8 | 22.96 | 23.59 | 24.23 | 24.86 | 25.50 | 26.14 | 26.78 | 27.42 | 30.60 |
| 11/16 | 24.86 | 25.55 | 26.24 | 26.94 | 27.62 | 28.32 | 29.00 | 29.69 | 33.15 |
| 3/4 | 26.78 | 27.52 | 28.26 | 29.01 | 29.75 | 30.50 | 31.24 | 31.98 | 35.70 |
| 13/16 | 28.69 | 29.49 | 30.28 | 31.08 | 31.88 | 32.67 | 33.48 | 34.28 | 38.25 |
| 7/8 | 30.60 | 31.45 | 32.30 | 33.15 | 34.00 | 34.85 | 35.70 | 36.55 | 40.80 |
| 15/16 | 32.52 | 33.41 | 34.32 | 35.22 | 36.12 | 37.03 | 37.92 | 38.83 | 43.35 |
| 1 | 34.43 | 35.38 | 36.34 | 37.29 | 38.25 | 39.21 | 40.17 | 41.12 | 45.90 |
| 1 1/16 | 36.34 | 37.35 | 38.36 | 39.37 | 40.38 | 41.39 | 42.40 | 43.40 | 48.45 |
| 1 1/8 | 38.26 | 39.31 | 40.37 | 41.44 | 42.50 | 43.56 | 44.63 | 45.69 | 51.00 |
| 1 3/16 | 40.16 | 41.28 | 42.40 | 43.52 | 44.64 | 45.75 | 46.86 | 47.97 | 53.55 |
| 1 1/4 | 42.08 | 43.25 | 44.41 | 45.58 | 46.75 | 47.92 | 49.08 | 50.25 | 56.10 |
| 1 5/16 | 44.00 | 45.22 | 46.44 | 47.66 | 48.88 | 50.10 | 51.32 | 52.54 | 58.65 |
| 1 3/8 | 45.90 | 47.18 | 48.45 | 49.73 | 51.00 | 52.28 | 53.55 | 54.83 | 61.20 |
| 1 7/16 | 47.82 | 49.14 | 50.48 | 51.80 | 53.14 | 54.46 | 55.78 | 57.11 | 63.75 |
| 1 1/2 | 49.73 | 51.10 | 52.49 | 53.87 | 55.25 | 56.63 | 58.02 | 59.40 | 66.30 |
| 1 9/16 | 51.64 | 53.07 | 54.51 | 55.94 | 57.38 | 58.81 | 60.24 | 61.68 | 68.85 |
| 1 5/8 | 53.56 | 55.04 | 56.53 | 58.01 | 59.50 | 60.99 | 62.48 | 63.97 | 71.40 |
| 1 11/16 | 55.46 | 57.00 | 58.54 | 60.09 | 61.62 | 63.17 | 64.70 | 66.24 | 73.95 |
| 1 3/4 | 57.38 | 58.97 | 60.56 | 62.16 | 63.75 | 65.35 | 66.94 | 68.53 | 76.50 |
| 1 13/16 | 59.29 | 60.94 | 62.58 | 64.23 | 65.88 | 67.52 | 69.18 | 70.83 | 79.05 |
| 2 | 61.20 | 62.90 | 64.60 | 66.30 | 68.00 | 69.70 | 71.40 | 73.10 | 81.60 |

## WEIGHTS OF FLAT ROLLED STEEL BA

### PER LINEAL FOOT.

(CONTINUED.)

| Thickness in Inches. | 11″ | 11¼″ | 11½″ | 11¾″ | 12″ | 12¼″ | 12½″ | 12 |
|---|---|---|---|---|---|---|---|---|
| 3/16 | 7.02 | 7.17 | 7.32 | 7.49 | 7.65 | 7.82 | 7.98 | 8. |
| 1/4 | 9.34 | 9.57 | 9.78 | 10.00 | 10.20 | 10.42 | 10.63 | 10. |
| 5/16 | 11.68 | 11.95 | 12.22 | 12.49 | 12.75 | 13.01 | 13.28 | 13. |
| 3/8 | 14.03 | 14.35 | 14.68 | 14.99 | 15.30 | 15.62 | 15.94 | 16. |
| 7/16 | 16.36 | 16.74 | 17.12 | 17.49 | 17.85 | 18.23 | 18.60 | 18. |
| 1/2 | 18.70 | 19.13 | 19.55 | 19.97 | 20.40 | 20.82 | 21.25 | 21. |
| 9/16 | 21.02 | 21.51 | 22.00 | 22.48 | 22.95 | 23.43 | 23.90 | 24. |
| 5/8 | 23.38 | 23.91 | 24.44 | 24.97 | 25.50 | 26.03 | 26.56 | 27. |
| 11/16 | 25.70 | 26.30 | 26.88 | 27.47 | 28.05 | 28.64 | 29.22 | 29. |
| 3/4 | 28.05 | 28.68 | 29.33 | 29.97 | 30.60 | 31.25 | 31.88 | 32. |
| 13/16 | 30.40 | 31.08 | 31.76 | 32.46 | 33.15 | 33.83 | 34.53 | 35. |
| 7/8 | 32.72 | 33.47 | 34.21 | 34.95 | 35.70 | 36.44 | 37.19 | 37. |
| 15/16 | 35.06 | 35.86 | 36.66 | 37.46 | 38.25 | 39.05 | 39.84 | 40. |
| 1 | 37.40 | 38.25 | 39.10 | 39.95 | 40.80 | 41.65 | 42.50 | 43. |
| 1 1/16 | 39.74 | 40.64 | 41.54 | 42.45 | 43.35 | 44.25 | 45.16 | 46. |
| 1 1/8 | 42.08 | 43.04 | 44.00 | 44.94 | 45.90 | 46.86 | 47.82 | 48. |
| 1 3/16 | 44.42 | 45.42 | 46.44 | 47.45 | 48.45 | 49.46 | 50.46 | 51. |
| 1 1/4 | 46.76 | 47.82 | 48.88 | 49.94 | 51.00 | 52.06 | 53.12 | 54. |
| 1 5/16 | 49.08 | 50.20 | 51.32 | 52.44 | 53.55 | 54.67 | 55.78 | 56. |
| 1 3/8 | 51.42 | 52.59 | 53.76 | 54.93 | 56.10 | 57.27 | 58.44 | 59. |
| 1 7/16 | 53.76 | 54.99 | 56.21 | 57.43 | 58.65 | 59.87 | 61.10 | 62. |
| 1 1/2 | 56.10 | 57.37 | 58.65 | 59.93 | 61.20 | 62.48 | 63.75 | 65. |
| 1 9/16 | 58.42 | 59.76 | 61.10 | 62.43 | 63.75 | 65.08 | 66.40 | 67. |
| 1 5/8 | 60.78 | 62.16 | 63.54 | 64.92 | 66.30 | 67.68 | 69.06 | 70. |
| 1 11/16 | 63.10 | 64.55 | 65.98 | 67.42 | 68.85 | 70.29 | 71.72 | 73. |
| 1 3/4 | 65.45 | 66.93 | 68.43 | 69.92 | 71.40 | 72.90 | 74.38 | 75. |
| 1 13/16 | 67.80 | 69.33 | 70.86 | 72.41 | 73.95 | 75.48 | 77.03 | 78. |
| 1 7/8 | 70.12 | 71.72 | 73.31 | 74.90 | 76.50 | 78.09 | 79.69 | 81. |
| 1 15/16 | 72.46 | 74.11 | 75.76 | 77.41 | 79.05 | 80.70 | 82.34 | 83. |
| 2 | 74.80 | 76.50 | 78.20 | 79.90 | 81.60 | 83.30 | 85.00 | 86. |

# AREAS AND CIRCUMFERENCES OF CIRCLES.

For Diameters from $\frac{1}{10}$ to 100, advancing by Tenths.

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 0.0 | | | 4.0 | 12.5664 | 12.5664 |
| .1 | .007854 | .31416 | .1 | 13.2025 | 12.8805 |
| .2 | .031416 | .62832 | .2 | 13.8544 | 13.1947 |
| .3 | .070686 | .94248 | .3 | 14.5220 | 13.5088 |
| .4 | .12566 | 1.2566 | .4 | 15.2053 | 13.8230 |
| .5 | .19635 | 1.5708 | .5 | 15.9043 | 14.1372 |
| .6 | .28274 | 1.8850 | .6 | 16.6190 | 14.4513 |
| .7 | .38485 | 2.1991 | .7 | 17.3494 | 14.7655 |
| .8 | .50266 | 2.5133 | .8 | 18.0956 | 15.0796 |
| .9 | .63617 | 2.8274 | .9 | 18.8574 | 15.3938 |
| 1.0 | .7854 | 3.1416 | 5.0 | 19.6350 | 15.7080 |
| .1 | .9503 | 3.4558 | .1 | 20.4282 | 16.0221 |
| .2 | 1.1310 | 3.7699 | .2 | 21.2372 | 16.3363 |
| .3 | 1.3273 | 4.0841 | .3 | 22.0618 | 16.6504 |
| .4 | 1.5394 | 4.3982 | .4 | 22.9022 | 16.9646 |
| .5 | 1.7671 | 4.7124 | .5 | 23.7583 | 17.2788 |
| .6 | 2.0106 | 5.0265 | .6 | 24.6301 | 17.5929 |
| .7 | 2.2698 | 5.3407 | .7 | 25.5176 | 17.9071 |
| .8 | 2.5447 | 5.6549 | .8 | 26.4208 | 18.2212 |
| .9 | 2.8353 | 5.9690 | .9 | 27.3397 | 18.5354 |
| 2.0 | 3.1416 | 6.2832 | 6.0 | 28.2743 | 18.8496 |
| .1 | 3.4636 | 6.5973 | .1 | 29.2247 | 19.1637 |
| .2 | 3.8013 | 6.9115 | .2 | 30.1907 | 19.4779 |
| .3 | 4.1548 | 7.2257 | .3 | 31.1725 | 19.7920 |
| .4 | 4.5239 | 7.5398 | .4 | 32.1699 | 20.1062 |
| .5 | 4.9087 | 7.8540 | .5 | 33.1831 | 20.4204 |
| .6 | 5.3093 | 8.1681 | .6 | 34.2119 | 20.7345 |
| .7 | 5.7256 | 8.4823 | .7 | 35.2565 | 21.0487 |
| .8 | 6.1575 | 8.7965 | .8 | 36.3168 | 21.3628 |
| .9 | 6.6052 | 9.1106 | .9 | 37.3928 | 21.6770 |
| 3.0 | 7.0686 | 9.4248 | 7.0 | 38.4845 | 21.9911 |
| .1 | 7.5477 | 9.7389 | .1 | 39.5919 | 22.3053 |
| .2 | 8.0425 | 10.0531 | .2 | 40.7150 | 22.6195 |
| .3 | 8.5530 | 10.3673 | .3 | 41.8539 | 22.9336 |
| .4 | 9.0792 | 10.6814 | .4 | 43.0084 | 23.2478 |
| .5 | 9.6211 | 10.9956 | .5 | 44.1786 | 23.5619 |
| .6 | 10.1788 | 11.3097 | .6 | 45.3646 | 23.8761 |
| .7 | 10.7521 | 11.6239 | .7 | 46.5663 | 24.1903 |
| .8 | 11.3411 | 11.9381 | .8 | 47.7836 | 24.5044 |
| .9 | 11.9459 | 12.2522 | .9 | 49.0167 | 24.8186 |

## AREAS AND CIRCUMFERENCES OF CIRCI

(CONTINUED)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circum |
|---|---|---|---|---|---|
| 8.0 | 50.2655 | 25.1327 | 12.0 | 113.0973 | 37. |
| .1 | 51.5300 | 25.4469 | .1 | 114.9901 | 38. |
| .2 | 52.8102 | 25.7611 | .2 | 116.8987 | 38. |
| .3 | 54.1061 | 26.0752 | .3 | 118.8229 | 38. |
| .4 | 55.4177 | 26.3894 | .4 | 120.7628 | 38. |
| .5 | 56.7450 | 26.7035 | .5 | 122.7185 | 39. |
| .6 | 58.0880 | 27.0177 | .6 | 124.6898 | 39. |
| .7 | 59.4468 | 27.3319 | .7 | 126.6769 | 39. |
| .8 | 60.8212 | 27.6460 | .8 | 128.6796 | 40. |
| .9 | 62.2114 | 27.9602 | .9 | 130.6981 | 40. |
| 9.0 | 63.6173 | 28.2743 | 13.0 | 132.7323 | 40. |
| .1 | 65.0388 | 28.5885 | .1 | 134.7822 | 41. |
| .2 | 66.4761 | 28.9027 | .2 | 136.8478 | 41. |
| .3 | 67.9291 | 29.2168 | .3 | 138.9291 | 41. |
| .4 | 69.3978 | 29.5310 | .4 | 141.0261 | 42. |
| .5 | 70.8822 | 29.8451 | .5 | 143.1388 | 42. |
| .6 | 72.3823 | 30.1593 | .6 | 145.2672 | 42. |
| .7 | 73.8981 | 30.4734 | .7 | 147.4114 | 43. |
| .8 | 75.4296 | 30.7876 | .8 | 149.5712 | 43. |
| .9 | 76.9769 | 31.1018 | .9 | 151.7468 | 43. |
| 10.0 | 78.5398 | 31.4159 | 14.0 | 153.9380 | 43. |
| .1 | 80.1185 | 31.7301 | .1 | 156.1450 | 44. |
| .2 | 81.7128 | 32.0442 | .2 | 158.3677 | 44. |
| .3 | 83.3229 | 32.3584 | .3 | 160.6061 | 44. |
| .4 | 84.9487 | 32.6726 | .4 | 162.8602 | 45. |
| .5 | 86.5901 | 32.9867 | .5 | 165.1300 | 45. |
| .6 | 88.2473 | 33.3009 | .6 | 167.4155 | 45. |
| .7 | 89.9202 | 33.6150 | .7 | 169.7167 | 46. |
| .8 | 91.6088 | 33.9292 | .8 | 172.0336 | 46. |
| .9 | 93.3132 | 34.2434 | .9 | 174.3662 | 46. |
| 11.0 | 95.0332 | 34.5575 | 15.0 | 176.7146 | 47. |
| .1 | 96.7689 | 34.8717 | .1 | 179.0786 | 47. |
| .2 | 98.5203 | 35.1858 | .2 | 181.4584 | 47. |
| .3 | 100.2875 | 35.5000 | .3 | 183.8539 | 48. |
| .4 | 102.0703 | 35.8142 | .4 | 186.2650 | 48. |
| .5 | 103.8689 | 36.1283 | .5 | 188.6919 | 48. |
| .6 | 105.6832 | 36.4425 | .6 | 191.1345 | 49. |
| .7 | 107.5132 | 36.7566 | .7 | 193.5928 | 49. |
| .8 | 109.3588 | 37.0708 | .8 | 196.0668 | 49. |
| .9 | 111.2202 | 37.3850 | .9 | 198.5565 | 5 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 16.0 | 201.0619 | 50.2655 | 20.0 | 314.1593 | 62.8319 |
| .1 | 203.5831 | 50.5796 | .1 | 317.3087 | 63.1460 |
| .2 | 206.1199 | 50.8938 | .2 | 320.4739 | 63.4602 |
| .3 | 208.6724 | 51.2080 | .3 | 323.6547 | 63.7743 |
| .4 | 211.2407 | 51.5221 | .4 | 326.8513 | 64.0885 |
| .5 | 213.8246 | 51.8363 | .5 | 330.0636 | 64.4026 |
| .6 | 216.4243 | 52.1504 | .6 | 333.2916 | 64.7168 |
| .7 | 219.0397 | 52.4646 | .7 | 336.5353 | 65.0310 |
| .8 | 221.6708 | 52.7788 | .8 | 339.7947 | 65.3451 |
| .9 | 224.3176 | 53.0929 | .9 | 343.0698 | 65.6593 |
| 17.0 | 226.9801 | 53.4071 | 21.0 | 346.3606 | 65.9734 |
| .1 | 229.6583 | 53.7212 | .1 | 349.6671 | 66.2876 |
| .2 | 232.3522 | 54.0354 | .2 | 352.9894 | 66.6018 |
| .3 | 235.0618 | 54.3496 | .3 | 356.3273 | 66.9159 |
| .4 | 237.7871 | 54.6637 | .4 | 359.6809 | 67.2301 |
| .5 | 240.5282 | 54.9779 | .5 | 363.0503 | 67.5442 |
| .6 | 243.2849 | 55.2920 | .6 | 366.4354 | 67.8584 |
| .7 | 246.0574 | 55.6062 | .7 | 369.8361 | 68.1726 |
| .8 | 248.8456 | 55.9203 | .8 | 373.2526 | 68.4867 |
| .9 | 251.6494 | 56.2345 | .9 | 376.6848 | 68.8009 |
| 18.0 | 254.4690 | 56.5486 | 22.0 | 380.1327 | 69.1150 |
| .1 | 257.3043 | 56.8628 | .1 | 383.5963 | 69.4292 |
| .2 | 260.1553 | 57.1770 | .2 | 387.0756 | 69.7434 |
| .3 | 263.0220 | 57.4911 | .3 | 390.5707 | 70.0575 |
| .4 | 265.9044 | 57.8053 | .4 | 394.0814 | 70.3717 |
| .5 | 268.8025 | 58.1195 | .5 | 397.6078 | 70.6858 |
| .6 | 271.7164 | 58.4336 | .6 | 401.1500 | 71.0000 |
| .7 | 274.6459 | 58.7478 | .7 | 404.7078 | 71.3142 |
| .8 | 277.5911 | 59.0619 | .8 | 408.2814 | 71.6283 |
| .9 | 280.5521 | 59.3761 | .9 | 411.8707 | 71.9425 |
| 19.0 | 283.5287 | 59.6903 | 23.0 | 415.4756 | 72.2566 |
| .1 | 286.5211 | 60.0044 | .1 | 419.0963 | 72.5708 |
| .2 | 289.5292 | 60.3186 | .2 | 422.7327 | 72.8849 |
| .3 | 292.5530 | 60.6327 | .3 | 426.3848 | 73.1991 |
| .4 | 295.5925 | 60.9469 | .4 | 430.0526 | 73.5133 |
| .5 | 298.6477 | 61.2611 | .5 | 433.7361 | 73.8274 |
| .6 | 301.7186 | 61.5752 | .6 | 437.4354 | 74.1416 |
| .7 | 304.8052 | 61.8894 | .7 | 441.1503 | 74.4557 |
| .8 | 307.9075 | 62.2035 | .8 | 444.8809 | 74.7699 |
| .9 | 311.0255 | 62.5177 | .9 | 448.6273 | 75.0841 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 24.0 | 452.3893 | 75.3982 | 28.0 | 615.7522 | 87.9646 |
| .1 | 456.1671 | 75.7124 | .1 | 620.1582 | 88.2788 |
| .2 | 459.9606 | 76.0265 | .2 | 624.5800 | 88.5929 |
| .3 | 463.7698 | 76.3407 | .3 | 629.0175 | 88.9071 |
| .4 | 467.5947 | 76.6549 | .4 | 633.4707 | 89.2212 |
| .5 | 471.4352 | 76.9690 | .5 | 637.9397 | 89.5354 |
| .6 | 475.2916 | 77.2832 | .6 | 642.4243 | 89.8495 |
| .7 | 479.1636 | 77.5973 | .7 | 646.9246 | 90.1637 |
| .8 | 483.0513 | 77.9115 | .8 | 651.4407 | 90.4779 |
| .9 | 486.9547 | 78.2257 | .9 | 655.9724 | 90.7920 |
| 25.0 | 490.8739 | 78.5398 | 29.0 | 660.5199 | 91.1062 |
| .1 | 494.8087 | 78.8540 | .1 | 665.0830 | 91.4203 |
| .2 | 498.7592 | 79.1681 | .2 | 669.6619 | 91.7345 |
| .3 | 502.7255 | 79.4823 | .3 | 674.2565 | 92.0487 |
| .4 | 506.7075 | 79.7965 | .4 | 678.8668 | 92.3628 |
| .5 | 510.7052 | 80.1106 | .5 | 683.4928 | 92.6770 |
| .6 | 514.7185 | 80.4248 | .6 | 688.1345 | 92.9911 |
| .7 | 518.7476 | 80.7389 | .7 | 692.7919 | 93.3053 |
| .8 | 522.7924 | 81.0531 | .8 | 697.4650 | 93.6195 |
| .9 | 526.8529 | 81.3672 | .9 | 702.1538 | 93.9336 |
| 26.0 | 530.9292 | 81.6814 | 30.0 | 706.8583 | 94.2478 |
| .1 | 535.0211 | 81.9956 | .1 | 711.5786 | 94.5619 |
| .2 | 539.1287 | 82.3097 | .2 | 716.3145 | 94.8761 |
| .3 | 543.2521 | 82.6239 | .3 | 721.0662 | 95.1903 |
| .4 | 547.3911 | 82.9380 | .4 | 725.8336 | 95.5044 |
| .5 | 551.5459 | 83.2522 | .5 | 730.6167 | 95.8186 |
| .6 | 555.7163 | 83.5664 | .6 | 735.4154 | 96.1327 |
| .7 | 559.9025 | 83.8805 | .7 | 740.2299 | 96.4469 |
| .8 | 564.1044 | 84.1947 | .8 | 745.0601 | 96.7611 |
| .9 | 568.3220 | 84.5088 | .9 | 749.9060 | 97.0752 |
| 27.0 | 572.5553 | 84.8230 | 31.0 | 754.7676 | 97.3894 |
| .1 | 576.8043 | 85.1372 | .1 | 759.6450 | 97.7035 |
| .2 | 581.0690 | 85.4513 | .2 | 764.5380 | 98.0177 |
| .3 | 585.3494 | 85.7655 | .3 | 769.4467 | 98.3319 |
| .4 | 589.6455 | 86.0796 | .4 | 774.3712 | 98.6460 |
| .5 | 593.9574 | 86.3938 | .5 | 779.3113 | 98.9602 |
| .6 | 598.2849 | 86.7080 | .6 | 784.2672 | 99.2743 |
| .7 | 602.6282 | 87.0221 | .7 | 789.2388 | 99.5885 |
| .8 | 606.9871 | 87.3363 | .8 | 794.2260 | 99.9026 |
| .9 | 611.3618 | 87.6504 | .9 | 799.2290 | 100.2168 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 32.0 | 804.2477 | 100.5310 | 36.0 | 1017.8760 | 113.0973 |
| .1 | 809.2821 | 100.8451 | .1 | 1023.5387 | 113.4115 |
| .2 | 814.3322 | 101.1593 | .2 | 1029.2172 | 113.7257 |
| .3 | 819.3980 | 101.4734 | .3 | 1034.9113 | 114.0398 |
| .4 | 824.4796 | 101.7876 | .4 | 1040.6212 | 114.3540 |
| .5 | 829.5768 | 102.1018 | .5 | 1046.3467 | 114.6681 |
| .6 | 834.6898 | 102.4159 | .6 | 1052.0880 | 114.9823 |
| .7 | 839.8185 | 102.7301 | .7 | 1057.8449 | 115.2965 |
| .8 | 844.9628 | 103.0442 | .8 | 1063.6176 | 115.6106 |
| .9 | 850.1229 | 103.3584 | .9 | 1069.4060 | 115.9248 |
| 33.0 | 855.2986 | 103.6726 | 37.0 | 1075.2101 | 116.2389 |
| .1 | 860.4902 | 103.9867 | .1 | 1081.0299 | 116.5531 |
| .2 | 865.6973 | 104.3009 | .2 | 1086.8654 | 116.8672 |
| .3 | 870.9202 | 104.6150 | .3 | 1092.7166 | 117.1814 |
| .4 | 876.1588 | 104.9292 | .4 | 1098.5835 | 117.4956 |
| .5 | 881.4131 | 105.2434 | .5 | 1104.4662 | 117.8097 |
| .6 | 886.6831 | 105.5575 | .6 | 1110.3645 | 118.1239 |
| .7 | 891.9688 | 105.8717 | .7 | 1116.2786 | 118.4380 |
| .8 | 897.2703 | 106.1858 | .8 | 1122.2083 | 118.7522 |
| .9 | 902.5874 | 106.5000 | .9 | 1128.1538 | 119.0664 |
| 34.0 | 907.9203 | 106.8142 | 38.0 | 1134.1149 | 119.3805 |
| .1 | 913.2688 | 107.1283 | .1 | 1140.0918 | 119.6947 |
| .2 | 918.6331 | 107.4425 | .2 | 1146.0844 | 120.0088 |
| .3 | 924.0131 | 107.7566 | .3 | 1152.0927 | 120.3230 |
| .4 | 929.4088 | 108.0708 | .4 | 1158.1167 | 120.6372 |
| .5 | 934.8202 | 108.3849 | .5 | 1164.1564 | 120.9513 |
| .6 | 940.2473 | 108.6991 | .6 | 1170.2118 | 121.2655 |
| .7 | 945.6901 | 109.0133 | .7 | 1176.2830 | 121.5796 |
| .8 | 951.1486 | 109.3274 | .8 | 1182.3698 | 121.8938 |
| .9 | 956.6228 | 109.6416 | .9 | 1188.4724 | 122.2080 |
| 35.0 | 962.1128 | 109.9557 | 39.0 | 1194.5906 | 122.5221 |
| .1 | 967.6184 | 110.2699 | .1 | 1200.7246 | 122.8363 |
| .2 | 973.1397 | 110.5841 | .2 | 1206.8742 | 123.1504 |
| .3 | 978.6768 | 110.8982 | .3 | 1213.0396 | 123.4646 |
| .4 | 984.2296 | 111.2124 | .4 | 1219.2207 | 123.7788 |
| .5 | 989.7980 | 111.5265 | .5 | 1225.4175 | 124.0929 |
| .6 | 995.3822 | 111.8407 | .6 | 1231.6300 | 124.4071 |
| .7 | 1000.9821 | 112.1549 | .7 | 1237.8582 | 124.7212 |
| .8 | 1006.5977 | 112.4690 | .8 | 1244.1021 | 125.0354 |
| .9 | 1012.2290 | 112.7832 | .9 | 1250.3617 | 125.3496 |

## AREAS AND CIRCUMFERENCES OF CI

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. |
|---|---|---|---|---|
| 40.0 | 1256.6371 | 125.6637 | 44.0 | 1520.5308 |
| .1 | 1262.9281 | 125.9779 | .1 | 1527.4502 |
| .2 | 1269.2348 | 126.2920 | .2 | 1534.3853 |
| .3 | 1275.5573 | 126.6062 | .3 | 1541.3360 |
| .4 | 1281.8955 | 126.9203 | .4 | 1548.3025 |
| .5 | 1288.2493 | 127.2345 | .5 | 1555.2847 |
| .6 | 1294.6189 | 127.5487 | .6 | 1562.2826 |
| .7 | 1301.0042 | 127.8628 | .7 | 1569.2962 |
| .8 | 1307.4052 | 128.1770 | .8 | 1576.3255 |
| .9 | 1313.8219 | 128.4911 | .9 | 1583.3706 |
| 41.0 | 1320.2543 | 128.8053 | 45.0 | 1590.4313 |
| .1 | 1326.7024 | 129.1195 | .1 | 1597.5077 |
| .2 | 1333.1663 | 129.4336 | .2 | 1604.5999 |
| .3 | 1339.6458 | 129.7478 | .3 | 1611.7077 |
| .4 | 1346.1410 | 130.0619 | .4 | 1618.8313 |
| .5 | 1352.6520 | 130.3761 | .5 | 1625.9705 |
| .6 | 1359.1786 | 130.6903 | .6 | 1633.1255 |
| .7 | 1365.7210 | 131.0044 | .7 | 1640.2962 |
| .8 | 1372.2791 | 131.3186 | .8 | 1647.4826 |
| .9 | 1378.8529 | 131.6327 | .9 | 1654.6847 |
| 42.0 | 1385.4424 | 131.9469 | 46.0 | 1661.9025 |
| .1 | 1392.0476 | 132.2611 | .1 | 1669.1360 |
| .2 | 1398.6685 | 132.5752 | .2 | 1676.3853 |
| .3 | 1405.3051 | 132.8894 | .3 | 1683.6502 |
| .4 | 1411.9574 | 133.2035 | .4 | 1690.9308 |
| .5 | 1418.6254 | 133.5177 | .5 | 1698.2272 |
| .6 | 1425.3092 | 133.8318 | .6 | 1705.5392 |
| .7 | 1432.0086 | 134.1460 | .7 | 1712.8670 |
| .8 | 1438.7238 | 134.4602 | .8 | 1720.2105 |
| .9 | 1445.4546 | 134.7743 | .9 | 1727.5697 |
| 43.0 | 1452.2012 | 135.0885 | 47.0 | 1734.9445 |
| .1 | 1458.9635 | 135.4026 | .1 | 1742.3351 |
| .2 | 1465.7415 | 135.7168 | .2 | 1749.7414 |
| .3 | 1472.5352 | 136.0310 | .3 | 1757.1635 |
| .4 | 1479.3446 | 136.3451 | .4 | 1764.6012 |
| .5 | 1486.1697 | 136.6593 | .5 | 1772.0546 |
| .6 | 1493.0105 | 136.9734 | .6 | 1779.5237 |
| .7 | 1499.8670 | 137.2876 | .7 | 1787.0086 |
| .8 | 1506.7393 | 137.6018 | .8 | 1794.5091 |
| .9 | 1513.6272 | 137.9159 | .9 | 1802.0254 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 48.0 | 1809.5574 | 150.7964 | 52.0 | 2123.7166 | 163.3628 |
| .1 | 1817.1050 | 151.1106 | .1 | 2131.8926 | 163.6770 |
| .2 | 1824.6684 | 151.4248 | .2 | 2140.0843 | 163.9911 |
| .3 | 1832.2475 | 151.7389 | .3 | 2148.2917 | 164.3053 |
| .4 | 1839.8423 | 152.0531 | .4 | 2156.5149 | 164.6195 |
| .5 | 1847.4528 | 152.3672 | .5 | 2164.7537 | 164.9336 |
| .6 | 1855.0790 | 152.6814 | .6 | 2173.0082 | 165.2479 |
| .7 | 1862.7210 | 152.9956 | .7 | 2181.2785 | 165.5619 |
| .8 | 1870.3786 | 153.3097 | .8 | 2189.5644 | 165.8761 |
| .9 | 1878.0519 | 153.6239 | .9 | 2197.8661 | 166.1903 |
| 49.0 | 1885.7409 | 153.9380 | 53.0 | 2206.1834 | 166.5044 |
| .1 | 1893.4457 | 154.2522 | .1 | 2214.5165 | 166.8186 |
| .2 | 1901.1662 | 154.5664 | .2 | 2222.8653 | 167.1327 |
| .3 | 1908.9024 | 154.8805 | .3 | 2231.2298 | 167.4469 |
| .4 | 1916.6543 | 155.1947 | .4 | 2239.6100 | 167.7610 |
| .5 | 1924.4218 | 155.5088 | .5 | 2248.0059 | 168.0752 |
| .6 | 1932.2051 | 155.8230 | .6 | 2256.4175 | 168.3894 |
| .7 | 1940.0042 | 156.1372 | .7 | 2264.8448 | 168.7035 |
| .8 | 1947.8189 | 156.4513 | .8 | 2273.2879 | 169.0177 |
| .9 | 1955.6493 | 156.7655 | .9 | 2281.7466 | 169.3318 |
| 50.0 | 1963.4954 | 157.0796 | 54.0 | 2290.2210 | 169.6460 |
| .1 | 1971.3572 | 157.3938 | .1 | 2298.7112 | 169.9602 |
| .2 | 1979.2348 | 157.7080 | .2 | 2307.2171 | 170.2743 |
| .3 | 1987.1280 | 158.0221 | .3 | 2315.7386 | 170.5885 |
| .4 | 1995.0370 | 158.3363 | .4 | 2324.2759 | 170.9026 |
| .5 | 2002.9617 | 158.6504 | .5 | 2332.8289 | 171.2168 |
| .6 | 2010.9020 | 158.9646 | .6 | 2341.3976 | 171.5310 |
| .7 | 2018.8581 | 159.2787 | .7 | 2349.9820 | 171.8451 |
| .8 | 2026.8299 | 159.5929 | .8 | 2358.5821 | 172.1593 |
| .9 | 2034.8174 | 159.9071 | .9 | 2367.1979 | 172.4735 |
| 51.0 | 2042.8206 | 160.2212 | 55.0 | 2375.8294 | 172.7876 |
| .1 | 2050.8395 | 160.5354 | .1 | 2384.4767 | 173.1017 |
| .2 | 2058.8742 | 160.8495 | .2 | 2393.1396 | 173.4159 |
| .3 | 2066.9245 | 161.1637 | .3 | 2401.8183 | 173.7301 |
| .4 | 2074.9905 | 161.4779 | .4 | 2410.5126 | 174.0442 |
| .5 | 2083.0723 | 161.7920 | .5 | 2419.2227 | 174.3584 |
| .6 | 2091.1697 | 162.1062 | .6 | 2427.9485 | 174.6726 |
| .7 | 2099.2829 | 162.4203 | .7 | 2436.6899 | 174.9867 |
| .8 | 2107.4118 | 162.7345 | .8 | 2445.4471 | 175.3009 |
| .9 | 2115.5563 | 163.0487 | .9 | 2454.2200 | 175.6150 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 56.0 | 2463.0086 | 175.9292 | 60.0 | 2827.4334 | 188.4956 |
| .1 | 2471.8130 | 176.2433 | .1 | 2836.8660 | 188.8097 |
| .2 | 2480.6330 | 176.5575 | .2 | 2846.3144 | 189.1239 |
| .3 | 2489.4687 | 176.8717 | .3 | 2855.7784 | 189.4380 |
| .4 | 2498.3201 | 177.1858 | .4 | 2865.2582 | 189.7522 |
| .5 | 2507.1873 | 177.5000 | .5 | 2874.7536 | 190.0664 |
| .6 | 2516.0701 | 177.8141 | .6 | 2884.2648 | 190.3805 |
| .7 | 2524.9687 | 178.1283 | .7 | 2893.7917 | 190.6947 |
| .8 | 2533.8830 | 178.4425 | .8 | 2903.3343 | 191.0088 |
| .9 | 2542.8129 | 178.7566 | .9 | 2912.8926 | 191.3230 |
| 57.0 | 2551.7586 | 179.0708 | 61.0 | 2922.4666 | 191.6372 |
| .1 | 2560.7200 | 179.3849 | .1 | 2932.0563 | 191.9513 |
| .2 | 2569.6971 | 179.6991 | .2 | 2941.6617 | 192.2655 |
| .3 | 2578.6899 | 180.0133 | .3 | 2951.2828 | 192.5796 |
| .4 | 2587.6985 | 180.3274 | .4 | 2960.9197 | 192.8938 |
| .5 | 2596.7227 | 180.6416 | .5 | 2970.5722 | 193.2079 |
| .6 | 2605.7626 | 180.9557 | .6 | 2980.2405 | 193.5221 |
| .7 | 2614.8183 | 181.2699 | .7 | 2989.9244 | 193.8363 |
| .8 | 2623.8896 | 181.5841 | .8 | 2999.6241 | 194.1504 |
| .9 | 2632.9767 | 181.8982 | .9 | 3009.3395 | 194.4646 |
| 58.0 | 2642.0794 | 182.2124 | 62.0 | 3019.0705 | 194.7787 |
| .1 | 2651.1979 | 182.5265 | .1 | 3028.8173 | 195.0929 |
| .2 | 2660.3321 | 182.8407 | .2 | 3038.5798 | 195.4071 |
| .3 | 2669.4820 | 183.1549 | .3 | 3048.3580 | 195.7212 |
| .4 | 2678.6476 | 183.4690 | .4 | 3058.1520 | 196.0354 |
| .5 | 2687.8289 | 183.7832 | .5 | 3067.9616 | 196.3495 |
| .6 | 2697.0259 | 184.0973 | .6 | 3077.7869 | 196.6637 |
| .7 | 2706.2386 | 184.4115 | .7 | 3087.6279 | 196.9779 |
| .8 | 2715.4670 | 184.7256 | .8 | 3097.4847 | 197.2920 |
| .9 | 2724.7112 | 185.0398 | .9 | 3107.3571 | 197.6062 |
| 59.0 | 2733.9710 | 185.3540 | 63.0 | 3117.2453 | 197.9203 |
| .1 | 2743.2466 | 185.6681 | .1 | 3127.1492 | 198.2345 |
| .2 | 2752.5378 | 185.9823 | .2 | 3137.0688 | 198.5487 |
| .3 | 2761.8448 | 186.2964 | .3 | 3147.0040 | 198.8628 |
| .4 | 2771.1675 | 186.6106 | .4 | 3156.9550 | 199.1770 |
| .5 | 2780.5058 | 186.9248 | .5 | 3166.9217 | 199.4911 |
| .6 | 2789.8599 | 187.2389 | .6 | 3176.9043 | 199.8053 |
| .7 | 2799.2297 | 187.5531 | .7 | 3186.9023 | 200.1195 |
| .8 | 2808.6152 | 187.8672 | .8 | 3196.9161 | 200.4336 |
| .9 | 2818.0165 | 188.1814 | .9 | 3206.9456 | 200.7478 |

## AS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| | 3216.9909 | 201.0620 | 68.0 | 3631.6811 | 213.6283 |
| | 3227.0518 | 201.3761 | .1 | 3642.3704 | 213.9425 |
| | 3237.1285 | 201.6902 | .2 | 3653.0754 | 214.2566 |
| | 3247.2222 | 202.0044 | .3 | 3663.7960 | 214.5708 |
| | 3257.3289 | 202.3186 | .4 | 3674.5324 | 214.8849 |
| | 3267.4527 | 202.6327 | .5 | 3685.2845 | 215.1991 |
| | 3277.5922 | 202.9469 | .6 | 3696.0523 | 215.5133 |
| | 3287.7474 | 203.2610 | .7 | 3706.8359 | 215.8274 |
| | 3297.9183 | 203.5752 | .8 | 3717.6351 | 216.1416 |
| | 3308.1049 | 203.8894 | .9 | 3728.4500 | 216.4556 |
| .0 | 3318.3072 | 204.2035 | 69.0 | 3739.2807 | 216.7699 |
| .1 | 3328.5253 | 204.5176 | .1 | 3750.1270 | 217.0841 |
| .2 | 3338.7590 | 204.8318 | .2 | 3760.9891 | 217.3982 |
| .3 | 3349.0085 | 205.1460 | .3 | 3771.8668 | 217.7124 |
| .4 | 3359.2736 | 205.4602 | .4 | 3782.7603 | 218.0265 |
| .5 | 3369.5545 | 205.7743 | .5 | 3793.6695 | 218.3407 |
| .6 | 3379.8510 | 206.0885 | .6 | 3804.5944 | 218.6548 |
| .7 | 3390.1633 | 206.4026 | .7 | 3815.5350 | 218.9690 |
| .8 | 3400.4913 | 206.7168 | .8 | 3826.4913 | 219.2832 |
| .9 | 3410.8350 | 207.0310 | .9 | 3837.4633 | 219.5973 |
| 66.0 | 3421.1944 | 207.3451 | 70.0 | 3848.4510 | 219.9115 |
| .1 | 3431.5695 | 207.6593 | .1 | 3859.4544 | 220.2256 |
| .2 | 3441.9603 | 207.9734 | .2 | 3870.4736 | 220.5398 |
| .3 | 3452.3669 | 208.2876 | .3 | 3881.5084 | 220.8540 |
| .4 | 3462.7891 | 208.6017 | .4 | 3892.5590 | 221.1681 |
| .5 | 3473.2270 | 208.9159 | .5 | 3903.6252 | 221.4823 |
| .6 | 3483.6807 | 209.2301 | .6 | 3914.7072 | 221.7964 |
| .7 | 3494.1500 | 209.5442 | .7 | 3925.8049 | 222.1106 |
| .8 | 3504.6351 | 209.8584 | .8 | 3936.9182 | 222.4248 |
| .9 | 3515.1359 | 210.1725 | .9 | 3948.0473 | 222.7389 |
| 67.0 | 3525.6524 | 210.4867 | 71.0 | 3959.1921 | 223.0531 |
| .1 | 3536.1845 | 210.8009 | .1 | 3970.3526 | 223.3672 |
| .2 | 3546.7324 | 211.1150 | .2 | 3981.5289 | 223.6814 |
| .3 | 3557.2960 | 211.4292 | .3 | 3992.7208 | 223.9956 |
| .4 | 3567.8754 | 211.7433 | .4 | 4003.9284 | 224.3097 |
| .5 | 3578.4704 | 212.0575 | .5 | 4015.1518 | 224.6239 |
| .6 | 3589.0811 | 212.3717 | .6 | 4026.3908 | 224.9380 |
| .7 | 3599.7075 | 212.6858 | .7 | 4037.6456 | 225.2522 |
| .8 | 3610.3497 | 213.0000 | .8 | 4048.9160 | 225.5664 |
| .9 | 3621.0075 | 213.3141 | .9 | 4060.2022 | 225.8805 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 72.0 | 4071.5041 | 226.1947 | 76.0 | 4536.4598 | 238.7610 |
| .1 | 4082.8217 | 226.5088 | .1 | 4548.4057 | 239.0753 |
| .2 | 4094.1550 | 226.8230 | .2 | 4560.3673 | 239.3894 |
| .3 | 4105.5040 | 227.1371 | .3 | 4572.3446 | 239.7035 |
| .4 | 4116.8687 | 227.4513 | .4 | 4584.3377 | 240.0177 |
| .5 | 4128.2491 | 227.7655 | .5 | 4596.3464 | 240.3318 |
| .6 | 4139.6452 | 228.0796 | .6 | 4608.3708 | 240.6460 |
| .7 | 4151.0571 | 228.3938 | .7 | 4620.4110 | 240.9602 |
| .8 | 4162.4846 | 228.7079 | .8 | 4632.4669 | 241.2743 |
| .9 | 4173.9279 | 229.0221 | .9 | 4644.5384 | 241.5885 |
| 73.0 | 4185.3868 | 229.3363 | 77.0 | 4656.6257 | 241.9026 |
| .1 | 4196.8615 | 229.6504 | .1 | 4668.7287 | 242.2168 |
| .2 | 4208.3519 | 229.9646 | .2 | 4680.8474 | 242.5310 |
| .3 | 4219.8579 | 230.2787 | .3 | 4692.9818 | 242.8451 |
| .4 | 4231.3797 | 230.5929 | .4 | 4705.1319 | 243.1592 |
| .5 | 4242.9172 | 230.9071 | .5 | 4717.2977 | 243.4734 |
| .6 | 4254.4704 | 231.2212 | .6 | 4729.4792 | 243.7876 |
| .7 | 4266.0394 | 231.5354 | .7 | 4741.6765 | 244.1017 |
| .8 | 4277.6240 | 231.8495 | .8 | 4753.8894 | 244.4159 |
| .9 | 4289.2243 | 232.1637 | .9 | 4766.1181 | 244.7301 |
| 74.0 | 4300.8403 | 232.4779 | 78.0 | 4778.3624 | 245.0442 |
| .1 | 4312.4721 | 232.7920 | .1 | 4790.6225 | 245.3584 |
| .2 | 4324.1195 | 233.1062 | .2 | 4802.8983 | 245.6725 |
| .3 | 4335.7827 | 233.4203 | .3 | 4815.1897 | 245.9867 |
| .4 | 4347.4616 | 233.7345 | .4 | 4827.4969 | 246.3009 |
| .5 | 4359.1562 | 234.0487 | .5 | 4839.8198 | 246.6150 |
| .6 | 4370.8664 | 234.3628 | .6 | 4852.1584 | 246.9292 |
| .7 | 4382.5924 | 234.6770 | .7 | 4864.5128 | 247.2433 |
| .8 | 4394.3341 | 234.9911 | .8 | 4876.8828 | 247.5575 |
| .9 | 4406.0916 | 235.3053 | .9 | 4889.2685 | 247.8717 |
| 75.0 | 4417.8647 | 235.6194 | 79.0 | 4901.6699 | 248.1858 |
| .1 | 4429.6535 | 235.9336 | .1 | 4914.0871 | 248.5000 |
| .2 | 4441.4580 | 236.2478 | .2 | 4926.5199 | 248.8141 |
| .3 | 4453.2783 | 236.5619 | .3 | 4938.9685 | 249.1283 |
| .4 | 4465.1142 | 236.8761 | .4 | 4951.4328 | 249.4425 |
| .5 | 4476.9659 | 237.1902 | .5 | 4963.9127 | 249.7566 |
| .6 | 4488.8332 | 237.5044 | .6 | 4976.4084 | 250.0708 |
| .7 | 4500.7163 | 237.8186 | .7 | 4988.9198 | 250.3850 |
| .8 | 4512.6151 | 238.1327 | .8 | 5001.4469 | 250.6991 |
| .9 | 4524.5296 | 238.4469 | .9 | 5013.9897 | 251.0133 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 80.0 | 5026.5482 | 251.3274 | 84.0 | 5541.7694 | 263.8938 |
| .1 | 5039.1225 | 251.6416 | .1 | 5554.9720 | 264.2079 |
| .2 | 5051.7124 | 251.9557 | .2 | 5568.1902 | 264.5221 |
| .3 | 5064.3180 | 252.2699 | .3 | 5581.4242 | 264.8363 |
| .4 | 5076.9394 | 252.5840 | .4 | 5594.6739 | 265.1514 |
| .5 | 5089.5764 | 252.8982 | .5 | 5607.9392 | 265.4646 |
| .6 | 5102.2292 | 253.2124 | .6 | 5621.2203 | 265.7787 |
| .7 | 5114.8977 | 253.5265 | .7 | 5634.5171 | 266.0929 |
| .8 | 5127.5819 | 253.8407 | .8 | 5647.8296 | 266.4071 |
| .9 | 5140.2818 | 254.1548 | .9 | 5661.1578 | 266.7212 |
| 81.0 | 5152.9973 | 254.4690 | 85.0 | 5674.5017 | 267.0354 |
| .1 | 5165.7287 | 254.7832 | .1 | 5687.8614 | 267.3495 |
| .2 | 5178.4757 | 255.0973 | .2 | 5701.2367 | 267.6637 |
| .3 | 5191.2384 | 255.4115 | .3 | 5714.6277 | 267.9779 |
| .4 | 5204.0168 | 255.7256 | .4 | 5728.0345 | 268.2920 |
| .5 | 5216.8110 | 256.0398 | .5 | 5741.4569 | 268.6062 |
| .6 | 5229.6208 | 256.3540 | .6 | 5754.8951 | 268.9203 |
| .7 | 5242.4463 | 256.6681 | .7 | 5768.3490 | 269.2345 |
| .8 | 5255.2876 | 256.9823 | .8 | 5781.8185 | 269.5486 |
| .9 | 5268.1446 | 257.2966 | .9 | 5795.3038 | 269.8628 |
| 82.0 | 5281.0173 | 257.6106 | 86.0 | 5808.8048 | 270.1770 |
| .1 | 5293.9056 | 257.9247 | .1 | 5822.3215 | 270.4911 |
| .2 | 5306.8097 | 258.2389 | .2 | 5835.8539 | 270.8053 |
| .3 | 5319.7295 | 258.5531 | .3 | 5849.4020 | 271.1194 |
| .4 | 5332.6650 | 258.8672 | .4 | 5862.9659 | 271.4336 |
| .5 | 5345.6162 | 259.1814 | .5 | 5876.5454 | 271.7478 |
| .6 | 5358.5832 | 259.4956 | .6 | 5890.1407 | 272.0619 |
| .7 | 5371.5658 | 259.8097 | .7 | 5903.7516 | 272.3761 |
| .8 | 5384.5641 | 260.1239 | .8 | 5917.3783 | 272.6902 |
| .9 | 5397.5782 | 260.4380 | .9 | 5931.0206 | 273.0044 |
| 83.0 | 5410.6079 | 260.7522 | 87.0 | 5944.6787 | 273.3186 |
| .1 | 5423.6534 | 261.0663 | .1 | 5958.3525 | 273.6327 |
| .2 | 5436.7146 | 261.3805 | .2 | 5972.0420 | 273.9469 |
| .3 | 5449.7915 | 261.6947 | .3 | 5985.7472 | 274.2610 |
| .4 | 5462.8840 | 262.0088 | .4 | 5999.4681 | 274.5752 |
| .5 | 5475.9923 | 262.3230 | .5 | 6013.2047 | 274.8894 |
| .6 | 5489.1163 | 262.6371 | .6 | 6026.9570 | 275.2035 |
| .7 | 5502.2561 | 262.9513 | .7 | 6040.7250 | 275.5177 |
| .8 | 5515.4115 | 263.2655 | .8 | 6054.5088 | 275.83[illegible] |
| .9 | 5528.5826 | 263.5796 | .9 | 6068.3082 | 276.14[illegible] |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 88.0 | 6082.1234 | 276.4602 | 92.0 | 6647.6101 | 289.0265 |
| .1 | 6095.9542 | 276.7743 | .1 | 6662.0692 | 289.3407 |
| .2 | 6109.8008 | 277.0885 | .2 | 6676.5441 | 289.6548 |
| .3 | 6123.6631 | 277.4026 | .3 | 6691.0347 | 289.9690 |
| .4 | 6137.5411 | 277.7168 | .4 | 6705.5410 | 290.2832 |
| .5 | 6151.4348 | 278.0309 | .5 | 6720.0630 | 290.5973 |
| .6 | 6165.3442 | 278.3451 | .6 | 6734.6008 | 290.9115 |
| .7 | 6179.2693 | 278.6593 | .7 | 6749.1542 | 291.2256 |
| .8 | 6193.2101 | 278.9740 | .8 | 6763.7233 | 291.5398 |
| .9 | 6207.1666 | 279.2876 | .9 | 6778.3082 | 291.8540 |
| 89.0 | 6221.1389 | 279.6017 | 93.0 | 6792.9087 | 292.1681 |
| .1 | 6235.1268 | 279.9159 | .1 | 6807.5250 | 292.4823 |
| .2 | 6249.1304 | 280.2301 | .2 | 6822.1569 | 292.7964 |
| .3 | 6263.1498 | 280.5442 | .3 | 6836.8046 | 293.1106 |
| .4 | 6277.1849 | 280.8584 | .4 | 6851.4680 | 293.4248 |
| .5 | 6291.2356 | 281.1725 | .5 | 6866.1471 | 293.7389 |
| .6 | 6305.3021 | 281.4867 | .6 | 6880.8419 | 294.0531 |
| .7 | 6319.3843 | 281.8009 | .7 | 6895.5524 | 294.3672 |
| .8 | 6333.4822 | 282.1150 | .8 | 6910.2786 | 294.6814 |
| .9 | 6347.5958 | 282.4292 | .9 | 6925.0205 | 294.9956 |
| 90.0 | 6361.7251 | 282.7433 | 94.0 | 6939.7782 | 295.3097 |
| .1 | 6375.8701 | 283.0575 | .1 | 6954.5515 | 295.6239 |
| .2 | 6390.0309 | 283.3717 | .2 | 6969.3106 | 295.9380 |
| .3 | 6404.2073 | 283.6858 | .3 | 6984.1453 | 296.2522 |
| .4 | 6418.3995 | 284.0000 | .4 | 6998.9658 | 296.5663 |
| .5 | 6432.6073 | 284.3141 | .5 | 7013.8019 | 296.8805 |
| .6 | 6446.8309 | 284.6283 | .6 | 7028.6538 | 297.1947 |
| .7 | 6461.0701 | 284.9425 | .7 | 7043.5214 | 297.5088 |
| .8 | 6475.3251 | 285.2566 | .8 | 7058.4047 | 297.8230 |
| .9 | 6489.5958 | 285.5708 | .9 | 7073.3033 | 298.1371 |
| 91.0 | 6503.8822 | 285.8849 | 95.0 | 7088.2184 | 298.4513 |
| .1 | 6518.1843 | 286.1991 | .1 | 7103.1488 | 298.7655 |
| .2 | 6532.5021 | 286.5133 | .2 | 7118.1950 | 299.0796 |
| .3 | 6546.8356 | 286.8274 | .3 | 7133.0568 | 299.3938 |
| .4 | 6561.1848 | 287.1416 | .4 | 7148.0343 | 299.7079 |
| .5 | 6575.5498 | 287.4557 | .5 | 7163.0276 | 300.0221 |
| .6 | 6589.9304 | 287.7699 | .6 | 7178.0366 | 300.3363 |
| .7 | 6604.3268 | 288.0840 | .7 | 7193.0612 | 300.6504 |
| .8 | 6618.7388 | 288.3982 | .8 | 7208.1016 | 300.9646 |
| .9 | 6633.1666 | 288.7124 | .9 | 7223.1577 | 301.2787 |

## AREAS AND CIRCUMFERENCES OF CIRCLES.

(CONTINUED.)

| Diameter. | Area. | Circumference. | Diameter. | Area. | Circumference. |
|---|---|---|---|---|---|
| 96.0 | 7238.2295 | 301.5929 | 98.0 | 7542.9640 | 307.8761 |
| .1 | 7253.3170 | 301.9071 | .1 | 7558.3656 | 308.1902 |
| .2 | 7268.4202 | 302.2212 | .2 | 7573.7830 | 308.5044 |
| .3 | 7283.5391 | 302.5354 | .3 | 7589.2161 | 308.8186 |
| .4 | 7298.6737 | 302.8405 | .4 | 7604.6648 | 309.1327 |
| .5 | 7313.8240 | 303.1637 | .5 | 7620.1293 | 309.4469 |
| .6 | 7328.9901 | 303.4779 | .6 | 7635.6095 | 309.7610 |
| .7 | 7344.1718 | 303.7920 | .7 | 7651.1054 | 310.0752 |
| .8 | 7359.3693 | 304.1062 | .8 | 7666.6170 | 310.3894 |
| .9 | 7374.5824 | 304.4203 | .9 | 7682.1444 | 310.7035 |
| 97.0 | 7389.8113 | 304.7345 | 99.0 | 7697.6893 | 311.0177 |
| .1 | 7405.0559 | 305.0486 | .1 | 7713.2461 | 311.3318 |
| .2 | 7420.3162 | 305.3628 | .2 | 7728.8206 | 311.6460 |
| .3 | 7435.5922 | 305.6770 | .3 | 7744.4107 | 311.9602 |
| .4 | 7450.8839 | 305.9911 | .4 | 7760.0166 | 312.2743 |
| .5 | 7466.1913 | 306.3053 | .5 | 7775.6382 | 312.5885 |
| .6 | 7481.5144 | 306.6194 | .6 | 7791.2754 | 312.9026 |
| .7 | 7496.8532 | 306.9336 | .7 | 7806.9284 | 313.2168 |
| .8 | 7512.2078 | 307.2478 | .8 | 7822.5971 | 313.5309 |
| .9 | 7527.5780 | 307.5619 | .9 | 7838.2815 | 313.8451 |
| | | | 100.0 | 7853.9816 | 314.1593 |

To find from the table areas or circumferences for larger diameters than those given.

### Case I.

For diameters greater than 100 and less than 1 001 :

Take from the table the area or circumference for a circle the diameter of which is one-tenth of the given diameter.

To obtain the required area or circumference, multiply the area so found by 100 and the circumference so found by 10.

For Example.—What is the area and circumference corresponding to a diameter of 459?

From the tables the area and circumference for diameter 45.9 are 1 654.6847 and 144.1991. Therefore 165 468.47 and 1 441.991 are the area and circumference required.

### Case II.

For diameters greater than 1000:

Divide the given diameter by any convenient factor which will give as a quotient a diameter found in the table, and take from the table the area or circumference for this diameter.

To obtain the required area or circumference multiply the area so found by the square of the factor and the circumference so found by the factor.

For Example.—What is the area and circumference corresponding to a diameter of 1 983?

1 983 ÷ 3 = 661. From the tables and Case I the area and circumference for diameter *661 are 343 156.95* and 20 765.93. Therefore 343 156.95 × 9 = 3 088 412.55 = area *required, and 20 765.93* × 3 = 62 297.79 = circumference required.

## LOGARITHMS OF NUMBERS, FROM 0 TO

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 00000 | 30103 | 47712 | 60206 | 69897 | 77815 | 84510 | 90 |
| 10 | 00000 | 00432 | 00860 | 01283 | 01703 | 02118 | 02530 | 02938 | 03 |
| 11 | 04139 | 04532 | 04921 | 05307 | 05690 | 06069 | 06445 | 06818 | 07 |
| 12 | 07918 | 08278 | 08636 | 08990 | 09342 | 09691 | 10037 | 10380 | 10 |
| 13 | 11394 | 11727 | 12057 | 12385 | 12710 | 13033 | 13353 | 13672 | 13 |
| 14 | 14613 | 14921 | 15228 | 15533 | 15836 | 16136 | 16435 | 16731 | 17 |
| 15 | 17609 | 17897 | 18184 | 18469 | 18752 | 19033 | 19312 | 19590 | 19 |
| 16 | 20412 | 20682 | 20951 | 21218 | 21484 | 21748 | 22010 | 22271 | 22 |
| 17 | 23045 | 23299 | 23552 | 23804 | 24054 | 24303 | 24551 | 24797 | 25 |
| 18 | 25527 | 25767 | 26007 | 26245 | 26481 | 26717 | 26951 | 27184 | 27 |
| 19 | 27875 | 28103 | 28330 | 28555 | 28780 | 29003 | 29225 | 29446 | 29 |
| 20 | 30103 | 30319 | 30535 | 30749 | 30963 | 31175 | 31386 | 31597 | 31 |
| 21 | 32222 | 32428 | 32633 | 32838 | 33041 | 33243 | 33445 | 33646 | 33 |
| 22 | 34242 | 34439 | 34635 | 34830 | 35024 | 35218 | 35410 | 35602 | 35 |
| 23 | 36173 | 36361 | 36548 | 36735 | 36921 | 37106 | 37291 | 37474 | 37 |
| 24 | 38021 | 38201 | 38381 | 38560 | 38739 | 38916 | 39093 | 39269 | 39 |
| 25 | 39794 | 39967 | 40140 | 40312 | 40483 | 40654 | 40824 | 40993 | 41 |
| 26 | 41497 | 41664 | 41830 | 41995 | 42160 | 42324 | 42488 | 42651 | 42 |
| 27 | 43136 | 43296 | 43456 | 43616 | 43775 | 43933 | 44090 | 44248 | 44 |
| 28 | 44716 | 44870 | 45024 | 45178 | 45331 | 45484 | 45636 | 45788 | 45 |
| 29 | 46240 | 46389 | 46538 | 46686 | 46834 | 46982 | 47129 | 47275 | 47 |
| 30 | 47712 | 47856 | 48000 | 48144 | 48287 | 48430 | 48572 | 48713 | 48 |
| 31 | 49136 | 49276 | 49415 | 49554 | 49693 | 49831 | 49968 | 50105 | 50 |
| 32 | 50515 | 50650 | 50785 | 50920 | 51054 | 51188 | 51321 | 51454 | 51 |
| 33 | 51851 | 51982 | 52113 | 52244 | 52374 | 52504 | 52633 | 52763 | 52 |
| 34 | 53148 | 53275 | 53402 | 53529 | 53655 | 53781 | 53907 | 54033 | 54 |
| 35 | 54407 | 54530 | 54654 | 54777 | 54900 | 55022 | 55145 | 55266 | 55 |
| 36 | 55630 | 55750 | 55870 | 55990 | 56110 | 56229 | 56348 | 56466 | 56 |
| 37 | 56820 | 56937 | 57054 | 57170 | 57287 | 57403 | 57518 | 57634 | 57 |
| 38 | 57978 | 58092 | 58206 | 58319 | 58433 | 58546 | 58658 | 58771 | 58 |
| 39 | 59106 | 59217 | 59328 | 59439 | 59549 | 59659 | 59769 | 59879 | 59 |
| 40 | 60206 | 60314 | 60422 | 60530 | 60638 | 60745 | 60852 | 60959 | 61 |
| 41 | 61278 | 61384 | 61489 | 61595 | 61700 | 61804 | 61909 | 62013 | 62 |
| 42 | 62325 | 62428 | 62531 | 62634 | 62736 | 62838 | 62941 | 63042 | 63 |
| 43 | 63347 | 63447 | 63548 | 63648 | 63749 | 63848 | 63948 | 64048 | 64 |
| 44 | 64345 | 64443 | 64542 | 64640 | 64738 | 64836 | 64933 | 65030 | 65 |
| 45 | 65321 | 65417 | 65513 | 65609 | 65705 | 65801 | 65896 | 65991 | 66 |
| 46 | 66276 | 66370 | 66464 | 66558 | 66651 | 66745 | 66838 | 66931 | 67 |
| 47 | 67210 | 67302 | 67394 | 67486 | 67577 | 67669 | 67760 | 67851 | 67 |
| 48 | 68124 | 68214 | 68304 | 68394 | 68484 | 68574 | 68663 | 68752 | 68 |
| 49 | 69020 | 69108 | 69196 | 69284 | 69372 | 69460 | 69548 | 69635 | 69 |
| 50 | 69897 | 69983 | 70070 | 70156 | 70243 | 70329 | 70415 | 70500 | 70 |
| *51* | *70757* | 70842 | 70927 | 71011 | 71096 | 71180 | 71265 | 71349 | 71 |
| *52* | *71600* | 71683 | 71767 | 71850 | 71933 | 72015 | 72098 | 72181 | 72 |
| *53* | *72428* | 72509 | 72591 | 72672 | 72754 | 72835 | 72916 | 72997 | 73 |
| *54* | *73239* | 73319 | 73399 | 73480 | 73559 | 73639 | 73719 | 73798 | 7 |

## LOGARITHMS OF NUMBERS, FROM 0 TO 1000.

(Continued.)

| No. | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 55 | 74036 | 74115 | 74193 | 74272 | 74351 | 74429 | 74507 | 74585 | 74663 | 74741 |
| 56 | 74818 | 74896 | 74973 | 75050 | 75127 | 75204 | 75281 | 75358 | 75434 | 75511 |
| 57 | 75587 | 75663 | 75739 | 75815 | 75891 | 75966 | 76042 | 76117 | 76192 | 76267 |
| 58 | 76342 | 76417 | 76492 | 76566 | 76641 | 76715 | 76789 | 76863 | 76937 | 77011 |
| 59 | 77085 | 77158 | 77232 | 77305 | 77378 | 77451 | 77524 | 77597 | 77670 | 77742 |
| 60 | 77815 | 77887 | 77959 | 78031 | 78103 | 78175 | 78247 | 78318 | 78390 | 78461 |
| 61 | 78533 | 78604 | 78675 | 78746 | 78816 | 78887 | 78958 | 79028 | 79098 | 79169 |
| 62 | 79239 | 79309 | 79379 | 79448 | 79518 | 79588 | 79657 | 79726 | 79796 | 79865 |
| 63 | 79934 | 80002 | 80071 | 80140 | 80208 | 80277 | 80345 | 80413 | 80482 | 80550 |
| 64 | 80618 | 80685 | 80753 | 80821 | 80888 | 80956 | 81023 | 81090 | 81157 | 81224 |
| 65 | 81291 | 81358 | 81424 | 81491 | 81557 | 81624 | 81690 | 81756 | 81822 | 81888 |
| 66 | 81954 | 82020 | 82085 | 82151 | 82216 | 82282 | 82347 | 82412 | 82477 | 82542 |
| 67 | 82607 | 82672 | 82736 | 82801 | 82866 | 82930 | 82994 | 83058 | 83123 | 83187 |
| 68 | 83250 | 83314 | 83378 | 83442 | 83505 | 83569 | 83632 | 83695 | 83758 | 83821 |
| 69 | 83884 | 83947 | 84010 | 84073 | 84136 | 84198 | 84260 | 84323 | 84385 | 84447 |
| 70 | 84509 | 84571 | 84633 | 84695 | 84757 | 84818 | 84880 | 84941 | 85003 | 85064 |
| 71 | 85125 | 85187 | 85248 | 85309 | 85369 | 85430 | 85491 | 85551 | 85612 | 85672 |
| 72 | 85733 | 85793 | 85853 | 85913 | 85973 | 86033 | 86093 | 86153 | 86213 | 86272 |
| 73 | 86332 | 86391 | 86451 | 86510 | 86569 | 86628 | 86687 | 86746 | 86805 | 86864 |
| 74 | 86923 | 86981 | 87040 | 87098 | 87157 | 87215 | 87273 | 87332 | 87390 | 87448 |
| 75 | 87506 | 87564 | 87621 | 87679 | 87737 | 87794 | 87852 | 87909 | 87966 | 88024 |
| 76 | 88081 | 88138 | 88195 | 88252 | 88309 | 88366 | 88422 | 88479 | 88536 | 88592 |
| 77 | 88649 | 88705 | 88761 | 88818 | 88874 | 88930 | 88986 | 89042 | 89098 | 89153 |
| 78 | 89209 | 89265 | 89320 | 89376 | 89431 | 89487 | 89542 | 89597 | 89652 | 89707 |
| 79 | 89762 | 89817 | 89872 | 89927 | 89982 | 90036 | 90091 | 90145 | 90200 | 90254 |
| 80 | 90309 | 90363 | 90417 | 90471 | 90525 | 90579 | 90633 | 90687 | 90741 | 90794 |
| 81 | 90848 | 90902 | 90955 | 91009 | 91062 | 91115 | 91169 | 91222 | 91275 | 91328 |
| 82 | 91381 | 91434 | 91487 | 91540 | 91592 | 91645 | 91698 | 91750 | 91803 | 91855 |
| 83 | 91907 | 91960 | 92012 | 92064 | 92116 | 92168 | 92220 | 92272 | 92324 | 92376 |
| 84 | 92427 | 92479 | 92531 | 92582 | 92634 | 92685 | 92737 | 92788 | 92839 | 92890 |
| 85 | 92941 | 92993 | 93044 | 93095 | 93146 | 93196 | 93247 | 93298 | 93348 | 93399 |
| 86 | 93449 | 93500 | 93550 | 93601 | 93651 | 93701 | 93751 | 93802 | 93852 | 93902 |
| 87 | 93951 | 94001 | 94051 | 94101 | 94151 | 94200 | 94250 | 94300 | 94349 | 91398 |
| 88 | 94448 | 94497 | 94546 | 94596 | 94645 | 94694 | 94743 | 94792 | 94841 | 94890 |
| 89 | 94939 | 94987 | 95036 | 95085 | 95133 | 95182 | 95230 | 95279 | 95327 | 95376 |
| 90 | 95424 | 95472 | 95520 | 95568 | 95616 | 95664 | 95712 | 95760 | 95808 | 95856 |
| 91 | 95904 | 95951 | 95999 | 96047 | 96094 | 96142 | 96189 | 96236 | 96284 | 96331 |
| 92 | 96378 | 96426 | 96473 | 96520 | 96567 | 96614 | 96661 | 96708 | 96754 | 96801 |
| 93 | 96848 | 96895 | 96941 | 96988 | 97034 | 97081 | 97127 | 97174 | 97220 | 97266 |
| 94 | 97312 | 97359 | 97405 | 97451 | 97497 | 97543 | 97589 | 97635 | 97680 | 97726 |
| 95 | 97772 | 97818 | 97863 | 97909 | 97954 | 98000 | 98045 | 98091 | 98136 | 98181 |
| 96 | 98227 | 98272 | 98317 | 98362 | 98407 | 98452 | 98497 | 98542 | 98587 | 98632 |
| 97 | 98677 | 98721 | 98766 | 98811 | 98855 | 98900 | 98945 | 98989 | 99033 | 99078 |
| 98 | 99122 | 99166 | 99211 | 99255 | 99299 | 99343 | 99387 | 99431 | 99475 | 99519 |
| 99 | 99563 | 99607 | 99651 | 99694 | 99738 | 99782 | 99825 | 99869 | 99913 | |

# NATURAL SINES, COSECANTS, TANGENTS, ETC.

| ° | ′ | Sine. | Cosecant. | Tangent. | Cotangent. | Secant. | Cosine. | ′ | ° |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | .000000 | Infinite. | .000000 | Infinite. | 1.00000 | 1.000000 | 0 | 90 |
| | 10 | .002909 | 343.77516 | .002909 | 343.77371 | 1.00000 | .999996 | 50 | |
| | 20 | .005818 | 171.88831 | .005818 | 171.88540 | 1.00002 | .999983 | 40 | |
| | 30 | .008727 | 114.59301 | .008727 | 114.58865 | 1.00004 | .999962 | 30 | |
| | 40 | .011635 | 85.945609 | .011636 | 85.939791 | 1.00007 | .999932 | 20 | |
| | 50 | .014544 | 68.757360 | .014545 | 68.750087 | 1.00011 | .999894 | 10 | |
| 1 | 0 | .017452 | 57.298688 | .017455 | 57.289962 | 1.00015 | .999848 | 0 | 89 |
| | 10 | .020361 | 49.114062 | .020365 | 49.103881 | 1.00021 | .999798 | 50 | |
| | 20 | .023269 | 42.975713 | .023275 | 42.964077 | 1.00027 | .999729 | 40 | |
| | 30 | .026177 | 38.201550 | .026186 | 38.188459 | 1.00034 | .999657 | 30 | |
| | 40 | .029085 | 34.382316 | .029097 | 34.367771 | 1.00042 | .999577 | 20 | |
| | 50 | .031992 | 31.257577 | .032009 | 31.241577 | 1.00051 | .999488 | 10 | |
| 2 | 0 | .034899 | 28.653708 | .034921 | 28.636253 | 1.00061 | .999391 | 0 | 88 |
| | 10 | .037806 | 26.450510 | .037834 | 26.431600 | 1.00072 | .999285 | 50 | |
| | 20 | .040713 | 24.562123 | .040747 | 24.541758 | 1.00083 | .999171 | 40 | |
| | 30 | .043619 | 22.925586 | .043661 | 22.903766 | 1.00095 | .999048 | 30 | |
| | 40 | .046525 | 21.493676 | .046576 | 21.470401 | 1.00108 | .998917 | 20 | |
| | 50 | .049431 | 20.230284 | .049491 | 20.205553 | 1.00122 | .998778 | 10 | |
| 3 | 0 | .052336 | 19.107323 | .052408 | 19.081137 | 1.00137 | .998630 | 0 | 87 |
| | 10 | .055241 | 18.102619 | .055325 | 18.074977 | 1.00153 | .998473 | 50 | |
| | 20 | .058145 | 17.198434 | .058243 | 17.169337 | 1.00169 | .998308 | 40 | |
| | 30 | .061049 | 16.380408 | .061163 | 16.349855 | 1.00187 | .998135 | 30 | |
| | 40 | .063952 | 15.636793 | .064083 | 15.604784 | 1.00205 | .997957 | 20 | |
| | 50 | .066854 | 14.957882 | .067004 | 14.924417 | 1.00224 | .997763 | 10 | |
| 4 | 0 | .069756 | 14.335587 | .069927 | 14.300666 | 1.00244 | .997564 | 0 | 86 |
| | 10 | .072658 | 13.763115 | .072851 | 13.726738 | 1.00265 | .997357 | 50 | |
| | 20 | .075559 | 13.234717 | .075776 | 13.196888 | 1.00287 | .997141 | 40 | |
| | 30 | .078459 | 12.745495 | .078702 | 12.706205 | 1.00309 | .996917 | 30 | |
| | 40 | .081359 | 12.291252 | .081629 | 12.250505 | 1.00333 | .996685 | 20 | |
| | 50 | .084258 | 11.868370 | .084558 | 11.826167 | 1.00357 | .996444 | 10 | |
| 5 | 0 | .087156 | 11.473713 | .087489 | 11.430052 | 1.00382 | .996195 | 0 | 85 |
| | 10 | .090053 | 11.104549 | .090421 | 11.059431 | 1.00408 | .995937 | 50 | |
| | 20 | .092950 | 10.758488 | .093354 | 10.711913 | 1.00435 | .995671 | 40 | |
| | 30 | .095846 | 10.433431 | .096289 | 10.385397 | 1.00463 | .995396 | 30 | |
| | 40 | .098741 | 10.127522 | .099226 | 10.078031 | 1.00491 | .995113 | 20 | |
| | 50 | .101635 | 9.8391227 | .102164 | 9.7881732 | 1.00521 | .994822 | 10 | |
| 6 | 0 | .104528 | 9.5667722 | .105104 | 9.5143645 | 1.00551 | .994522 | 0 | 84 |
| | 10 | .107421 | 9.3091699 | .108046 | 9.2553035 | 1.00582 | .994214 | 50 | |
| | 20 | .110313 | 9.0651512 | .110990 | 9.0098261 | 1.00614 | .993897 | 40 | 83 |
| ° | ′ | Cosine. | Secant. | Cotangent. | Tangent. | Cosecant. | Sine. | ′ | ° |

— ...nctions from 83°-40′ to 90° read from bottom of table upward.

# NATURAL SINES, COSECANTS, TANGENTS, ETC.

| ° | ′ | Sine. | Cosecant. | Tangent. | Cotangent. | Secant. | Cosine. | ′ | ° |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 30 | .113203 | 8.8336715 | .113936 | 8.7768874 | 1.00647 | .993572 | 30 | |
| | 40 | .116093 | 8.6137901 | .116883 | 8.5555468 | 1.00681 | .993238 | 20 | |
| | 50 | .118982 | 8.4045586 | .119833 | 8.3449558 | 1.00715 | .992896 | 10 | |
| 7 | 0 | .121869 | 8.2055090 | .122785 | 8.1443464 | 1.00751 | .992546 | 0 | 83 |
| | 10 | .124756 | 8.0156450 | .125738 | 7.9530224 | 1.00787 | .992187 | 50 | |
| | 20 | .127642 | 7.8344335 | .128694 | 7.7703506 | 1.00825 | .991820 | 40 | |
| | 30 | .130526 | 7.6612976 | .131653 | 7.5957541 | 1.00863 | .991445 | 30 | |
| | 40 | .133410 | 7.4957100 | .134613 | 7.4287064 | 1.00902 | .991061 | 20 | |
| | 50 | .136292 | 7.3371909 | .137576 | 7.2687255 | 1.00942 | .990669 | 10 | |
| 8 | 0 | .139173 | 7.1852965 | .140541 | 7.1153697 | 1.00983 | .990268 | 0 | 82 |
| | 10 | .142053 | 7.0396220 | .143508 | 6.9682335 | 1.01024 | .989859 | 50 | |
| | 20 | .144932 | 6.8997942 | .146478 | 6.8269437 | 1.01067 | .989442 | 40 | |
| | 30 | .147809 | 6.7654691 | .149451 | 6.6911562 | 1.01111 | .989016 | 30 | |
| | 40 | .150686 | 6.6363293 | .152426 | 6.5605538 | 1.01155 | .988582 | 20 | |
| | 50 | .153561 | 6.5120812 | .155404 | 6.4348428 | 1.01200 | .988139 | 10 | |
| 9 | 0 | .156434 | 6.3924532 | .158384 | 6.3137515 | 1.01247 | .987688 | 0 | 81 |
| | 10 | .159307 | 6.2771983 | .161368 | 6.1970279 | 1.01294 | .987229 | 50 | |
| | 20 | .162178 | 6.1660674 | .164354 | 6.0844381 | 1.01342 | .986762 | 40 | |
| | 30 | .165048 | 6.0588980 | .167343 | 5.9757644 | 1.01391 | .986286 | 30 | |
| | 40 | .167916 | 5.9553625 | .170334 | 5.8708042 | 1.01440 | .985801 | 20 | |
| | 50 | .170783 | 5.8553921 | .173329 | 5.7693688 | 1.01491 | .985309 | 10 | |
| 10 | 0 | .173648 | 5.7587705 | .176327 | 5.6712818 | 1.01543 | .984808 | 0 | 80 |
| | 10 | .176512 | 5.6653331 | .179328 | 5.5763786 | 1.01595 | .984298 | 50 | |
| | 20 | .179375 | 5.5749258 | .182332 | 5.4845052 | 1.01649 | .983781 | 40 | |
| | 30 | .182236 | 5.4874043 | .185339 | 5.3955172 | 1.01703 | .983255 | 30 | |
| | 40 | .185095 | 5.4026333 | .188359 | 5.3092793 | 1.01758 | .982721 | 20 | |
| | 50 | .187953 | 5.3204860 | .191363 | 5.2256647 | 1.01815 | .982178 | 10 | |
| 11 | 0 | .190809 | 5.2408431 | .194380 | 5.1445540 | 1.01872 | .981627 | 0 | 79 |
| | 10 | .193664 | 5.1635924 | .197401 | 5.0658352 | 1.01930 | .981068 | 50 | |
| | 20 | .196517 | 5.0886284 | .200425 | 4.9894027 | 1.01989 | .980500 | 40 | |
| | 30 | .199368 | 5.0158317 | .203452 | 4.9151570 | 1.02049 | .979925 | 30 | |
| | 40 | .202218 | 4.9451687 | .206483 | 4.8430045 | 1.02110 | .979341 | 20 | |
| | 50 | .205065 | 4.8764907 | .209518 | 4.7728568 | 1.02171 | .978748 | 10 | |
| 12 | 0 | .207912 | 4.8097343 | .212557 | 4.7046301 | 1.02234 | .978148 | 0 | 78 |
| | 10 | .210756 | 4.7448206 | .215599 | 4.6382457 | 1.02298 | .977539 | 50 | |
| | 20 | .213599 | 4.6816748 | .218645 | 4.5736287 | 1.02362 | .976921 | 40 | |
| | 30 | .216440 | 4.6202263 | .221695 | 4.5107085 | 1.02428 | .976296 | 30 | |
| | 40 | .219279 | 4.5604080 | .224748 | 4.4494181 | 1.02494 | .975662 | 20 | |
| | 50 | .222116 | 4.5021565 | .227806 | 4.3896940 | 1.02562 | .975020 | 10 | 77 |
| ° | ′ | Cosine. | Secant. | Cotangent. | Tangent. | Cosecant. | Sine. | ′ | ° |

*For functions from 77°-10′ to 88°-30′ read from bottom of table upward.*

# NATURAL SINES, COSECANTS, TANGENTS, ETC.

| ° | ′ | Sine. | Cosecant. | Tangent. | Cotangent. | Secant. | Cosine. | ′ | ° |
|---|---|---|---|---|---|---|---|---|---|
| 13 | 0 | .224951 | 4.4454115 | .230868 | 4.3314759 | 1.02630 | .974370 | 0 | 77 |
| | 10 | .227784 | 4.3901158 | .233934 | 4.2747066 | 1.02700 | .973712 | 50 | |
| | 20 | .230616 | 4.3362150 | .237004 | 4.2193318 | 1.02770 | .973045 | 40 | |
| | 30 | .233445 | 4.2836576 | .240079 | 4.1652998 | 1.02842 | .972370 | 30 | |
| | 40 | .236273 | 4.2323943 | .243158 | 4.1125614 | 1.02914 | .971687 | 20 | |
| | 50 | .239098 | 4.1823785 | .246241 | 4.0610700 | 1.02987 | .970995 | 10 | |
| 14 | 0 | .241922 | 4.1335655 | .249328 | 4.0107809 | 1.03061 | .970296 | 0 | 76 |
| | 10 | .244743 | 4.0859130 | .252420 | 3.9616518 | 1.03137 | .969588 | 50 | |
| | 20 | .247563 | 4.0393804 | .255517 | 3.9136420 | 1.03213 | .968872 | 40 | |
| | 30 | .250380 | 3.9939292 | .258618 | 3.8667131 | 1.03290 | .968148 | 30 | |
| | 40 | .253195 | 3.9495224 | .261723 | 3.8208281 | 1.03363 | .967415 | 20 | |
| | 50 | .256008 | 3.9061250 | .264834 | 3.7759519 | 1.03447 | .966675 | 10 | |
| 15 | 0 | .258819 | 3.8637033 | .267949 | 3.7320508 | 1.03528 | .965926 | 0 | 75 |
| | 10 | .261628 | 3.8222251 | .271069 | 3.6890927 | 1.03609 | .965169 | 50 | |
| | 20 | .264434 | 3.7816596 | .274195 | 3.6470467 | 1.03691 | .964404 | 40 | |
| | 30 | .267238 | 3.7419775 | .277325 | 3.6058835 | 1.03774 | .963630 | 30 | |
| | 40 | .270040 | 3.7031506 | .280460 | 3.5655749 | 1.03858 | .962849 | 20 | |
| | 50 | .272840 | 3.6651518 | .283600 | 3.5260938 | 1.03944 | .962059 | 10 | |
| 16 | 0 | .275637 | 3.6279553 | .286745 | 3.4874144 | 1.04030 | .961262 | 0 | 74 |
| | 10 | .278432 | 3.5915363 | .289896 | 3.4495120 | 1.04117 | .960456 | 50 | |
| | 20 | .281225 | 3.5558710 | .293052 | 3.4123626 | 1.04206 | .959642 | 40 | |
| | 30 | .284015 | 3.5209365 | .296214 | 3.3759434 | 1.04295 | .958820 | 30 | |
| | 40 | .286803 | 3.4867110 | .299380 | 3.3402326 | 1.04385 | .957990 | 20 | |
| | 50 | .289589 | 3.4531735 | .302553 | 3.3052091 | 1.04477 | .957151 | 10 | |
| 17 | 0 | .292372 | 3.4203036 | .305731 | 3.2708526 | 1.04569 | .956305 | 0 | 73 |
| | 10 | .295152 | 3.3880820 | .308914 | 3.2371438 | 1.04663 | .955450 | 50 | |
| | 20 | .297930 | 3.3564900 | .312104 | 3.2040638 | 1.04757 | .954588 | 40 | |
| | 30 | .300706 | 3.3255095 | .315299 | 3.1715948 | 1.04853 | .953717 | 30 | |
| | 40 | .303479 | 3.2951234 | .318500 | 3.1397194 | 1.04950 | .952838 | 20 | |
| | 50 | .306249 | 3.2653149 | .321707 | 3.1084210 | 1.05047 | .951951 | 10 | |
| 18 | 0 | .309017 | 3.2360680 | .324920 | 3.0776835 | 1.05146 | .951057 | 0 | 72 |
| | 10 | .311782 | 3.2073673 | .328139 | 3.0474915 | 1.05246 | .950154 | 50 | |
| | 20 | .314545 | 3.1791978 | .331364 | 3.0178301 | 1.05347 | .949243 | 40 | |
| | 30 | .317305 | 3.1515453 | .334595 | 2.9886850 | 1.05449 | .948324 | 30 | |
| | 40 | .320062 | 3.1243959 | .337833 | 2.9600422 | 1.05552 | .947397 | 20 | |
| | 50 | .322816 | 3.0977363 | .341077 | 2.9318885 | 1.05657 | .946462 | 10 | |
| 19 | 0 | .325568 | 3.0715535 | .344328 | 2.9042109 | 1.05762 | .945519 | 0 | 71 |
| | 10 | .328317 | 3.0458352 | .347585 | 2.8769970 | 1.05869 | .944568 | 50 | |
| | 20 | .331063 | 3.0205693 | .350848 | 2.8502349 | 1.05976 | .943609 | 40 | 70 |
| ° | ′ | Cosine. | Secant. | Cotangent. | Tangent. | Cosecant. | Sine. | ′ | ° |

For functions from 70°-40′ to 77°-0′ read from bottom of table upward.

# NATURAL SINES, COSECANTS, TANGENTS, ETC.

| | ′ | Sine. | Cosecant. | Tangent. | Cotangent. | Secant. | Cosine. | ′ | ° |
|---|---|---|---|---|---|---|---|---|---|
| | 30 | .333807 | 2.9957443 | .354119 | 2.8239129 | 1.06085 | .942641 | 30 | |
| | 40 | .336547 | 2.9713490 | .357396 | 2.7980198 | 1.06195 | .941666 | 20 | |
| | 50 | .339285 | 2.9473724 | .360680 | 2.7725448 | 1.06306 | .940684 | 10 | |
| | 0 | .342020 | 2.9238044 | .363970 | 2.7474774 | 1.06418 | .939693 | 0 | 70 |
| | 10 | .344752 | 2.9006346 | .367268 | 2.7228076 | 1.06531 | .938694 | 50 | |
| | 20 | .347481 | 2.8778532 | .370573 | 2.6985254 | 1.06645 | .937687 | 40 | |
| | 30 | .350207 | 2.8554510 | .373885 | 2.6746215 | 1.06761 | .936672 | 30 | |
| | 40 | .352931 | 2.8334185 | .377204 | 2.6510867 | 1.06878 | .935650 | 20 | |
| | 50 | .355651 | 2.8117471 | .380530 | 2.6279121 | 1.06995 | .934619 | 10 | |
| | 0 | .358368 | 2.7904281 | .383864 | 2.6050891 | 1.07115 | .933580 | 0 | 69 |
| | 10 | .361082 | 2.7694532 | .387205 | 2.5826094 | 1.07235 | .932534 | 50 | |
| | 20 | .363793 | 2.7488144 | .390554 | 2.5604649 | 1.07356 | .931480 | 40 | |
| | 30 | .366501 | 2.7285088 | .393911 | 2.5386479 | 1.07479 | .930418 | 30 | |
| | 40 | .369206 | 2.7085139 | .397275 | 2.5171507 | 1.07602 | .929348 | 20 | |
| | 50 | .371908 | 2.6888374 | .400647 | 2.4959661 | 1.07727 | .928270 | 10 | |
| | 0 | .374607 | 2.6694672 | .404026 | 2.4750869 | 1.07853 | .927184 | 0 | 68 |
| | 10 | .377302 | 2.6503962 | .407414 | 2.4545061 | 1.07981 | .926090 | 50 | |
| | 20 | .379994 | 2.6316180 | .410810 | 2.4342172 | 1.08109 | .924989 | 40 | |
| | 30 | .382683 | 2.6131259 | .414214 | 2.4142136 | 1.08239 | .923880 | 30 | |
| | 40 | .385369 | 2.5949137 | .417626 | 2.3944889 | 1.08370 | .922762 | 20 | |
| | 50 | .388052 | 2.5769758 | .421046 | 2.3750372 | 1.08503 | .921638 | 10 | |
| | 0 | .390731 | 2.5593047 | .424475 | 2.3558524 | 1.08636 | .920505 | 0 | 67 |
| | 10 | .393407 | 2.5418961 | .427912 | 2.3369287 | 1.08771 | .919364 | 50 | |
| | 20 | .396080 | 2.5247440 | .431358 | 2.3182606 | 1.08907 | .918216 | 40 | |
| | 30 | .398749 | 2.5078428 | .434812 | 2.2998425 | 1.09044 | .917060 | 30 | |
| | 40 | .401415 | 2.4911874 | .438276 | 2.2816693 | 1.09183 | .915896 | 20 | |
| | 50 | .404078 | 2.4747726 | .441748 | 2.2637357 | 1.09323 | .914725 | 10 | |
| | 0 | .406737 | 2.4585983 | .445229 | 2.2460368 | 1.09464 | .913545 | 0 | 66 |
| | 10 | .409392 | 2.4426448 | .448719 | 2.2285676 | 1.09606 | .912358 | 50 | |
| | 20 | .412045 | 2.4269222 | .452218 | 2.2113234 | 1.09750 | .911164 | 40 | |
| | 30 | .414693 | 2.4114210 | .455726 | 2.1942997 | 1.09895 | .909961 | 30 | |
| | 40 | .417338 | 2.3961367 | .459244 | 2.1774920 | 1.10041 | .908751 | 20 | |
| | 50 | .419980 | 2.3810650 | .462771 | 2.1608958 | 1.10189 | .907533 | 10 | |
| | 0 | .422618 | 2.3662016 | .466308 | 2.1445069 | 1.10338 | .906308 | 0 | 65 |
| | 10 | .425253 | 2.3515424 | .469854 | 2.1283213 | 1.10488 | .905075 | 50 | |
| | 20 | .427884 | 2.3370833 | .473410 | 2.1123348 | 1.10640 | .903834 | 40 | |
| | 30 | .430511 | 2.3228205 | .476976 | 2.0965436 | 1.10793 | .902585 | 30 | |
| | 40 | .433135 | 2.3087501 | .480551 | 2.0809438 | 1.10947 | .901329 | 20 | |
| | 50 | .435755 | 2.2948685 | .484137 | 2.0655318 | 1.11103 | .900065 | 10 | 64 |
| | ′ | Cosine. | Secant. | Cotangent. | Tangent. | Cosecant. | Sine. | ′ | ° |

*or functions from 64°-10′ to 70°-30′ read from bottom of table upward.*

# NATURAL SINES, COSECANT TANGENTS, ETC.

| ° | ′ | Sine. | Cosecant. | Tangent. | Cotangent. | Secant. | |
|---|---|---|---|---|---|---|---|
| 26 | 0 | .438371 | 2.2811720 | .487733 | 2.0503038 | 1.11260 | . |
| | 10 | .440984 | 2.2676571 | .491339 | 2.0352565 | 1.11419 | . |
| | 20 | .443593 | 2.2543204 | .494955 | 2.0203862 | 1.11579 | . |
| | 30 | .446198 | 2.2411585 | .498582 | 2.0056897 | 1.11740 | . |
| | 40 | .448799 | 2.2281681 | .502219 | 1.9911637 | 1.11903 | . |
| | 50 | .451397 | 2.2153460 | .505867 | 1.9768050 | 1.12067 | . |
| 27 | 0 | .453990 | 2.2026893 | .509525 | 1.9626105 | 1.12233 | . |
| | 10 | .456580 | 2.1901947 | .513195 | 1.9485772 | 1.12400 | . |
| | 20 | .459166 | 2.1778595 | .516876 | 1.9347020 | 1.12568 | . |
| | 30 | .461749 | 2.1656806 | .520567 | 1.9209821 | 1.12738 | . |
| | 40 | .464327 | 2.1536553 | .524270 | 1.9074147 | 1.12910 | . |
| | 50 | .466901 | 2.1417808 | .527984 | 1.8939971 | 1.13083 | . |
| 28 | 0 | .469472 | 2.1300545 | .531709 | 1.8807265 | 1.13257 | . |
| | 10 | .472038 | 2.1184737 | .535547 | 1.8676003 | 1.13433 | . |
| | 20 | .474600 | 2.1070359 | .539195 | 1.8546159 | 1.13610 | . |
| | 30 | .477159 | 2.0957385 | .542956 | 1.8417409 | 1.13789 | . |
| | 40 | .479713 | 2.0845792 | .546728 | 1.8290628 | 1.13970 | . |
| | 50 | .482263 | 2.0735556 | .550515 | 1.8164892 | 1.14152 | . |
| 29 | 0 | .484810 | 2.0626653 | .554309 | 1.8040478 | 1.14335 | . |
| | 10 | .487352 | 2.0519061 | .558118 | 1.7917362 | 1.14521 | . |
| | 20 | .489890 | 2.0412757 | .561939 | 1.7795524 | 1.14707 | . |
| | 30 | .492424 | 2.0307720 | .565773 | 1.7674940 | 1.14896 | . |
| | 40 | .494953 | 2.0203929 | .569619 | 1.7555590 | 1.15085 | . |
| | 50 | .497479 | 2.0101362 | .573478 | 1.7437453 | 1.15277 | . |
| 30 | 0 | .500000 | 2.0000000 | .577350 | 1.7320508 | 1.15470 | . |
| | 10 | .502517 | 1.9899822 | .581235 | 1.7204736 | 1.15665 | . |
| | 20 | .505030 | 1.9800810 | .585134 | 1.7090116 | 1.15861 | . |
| | 30 | .507538 | 1.9702944 | .589045 | 1.6976631 | 1.16059 | . |
| | 40 | .510043 | 1.9606206 | .592970 | 1.6864261 | 1.16259 | . |
| | 50 | .512543 | 1.9510577 | .596908 | 1.6752988 | 1.16460 | . |
| 31 | 0 | .515038 | 1.9416040 | .600861 | 1.6642795 | 1.16663 | . |
| | 10 | .517529 | 1.9322578 | .604827 | 1.6533663 | 1.16868 | . |
| | 20 | .520016 | 1.9230173 | .608807 | 1.6425576 | 1.17075 | . |
| | 30 | .522499 | 1.9138809 | .612801 | 1.6318517 | 1.17283 | . |
| | 40 | .524977 | 1.9048469 | .616809 | 1.6212469 | 1.17493 | . |
| | 50 | .527450 | 1.8959138 | .620832 | 1.6107417 | 1.17704 | . |
| 32 | 0 | .529919 | 1.8870799 | .624869 | 1.6003345 | 1.17918 | . |
| | 10 | .532384 | 1.8783438 | .628921 | 1.5900238 | 1.18133 | . |
| | 20 | .534844 | 1.8697040 | .632988 | 1.5798079 | 1.18350 | . |
| ° | ′ | Cosine. | Secant. | Cotangent. | Tangent. | Cosecant. | |

For functions from 57°-40′ to 64°-0′ read from bottom of

# NATURAL SINES, COSECANTS, TANGENTS, ETC.

| ° | ′ | Sine. | Cosecant. | Tangent. | Cotangent. | Secant. | Cosine. | ′ | ° |
|---|---|---|---|---|---|---|---|---|---|
| 32 | 30 | .537300 | 1.8611590 | .637079 | 1.5696856 | 1.18569 | .843391 | 30 | |
| | 40 | .539751 | 1.8527073 | .641167 | 1.5596552 | 1.18790 | .841825 | 20 | |
| | 50 | .542197 | 1.8443476 | .645280 | 1.5497155 | 1.19012 | .840251 | 10 | |
| 33 | 0 | .544639 | 1.8360785 | .649408 | 1.5398650 | 1.19236 | .838671 | 0 | 5 |
| | 10 | .547076 | 1.8278985 | .653531 | 1.5301025 | 1.19463 | .837083 | 50 | |
| | 20 | .549509 | 1.8198065 | .657710 | 1.5204261 | 1.19691 | .835488 | 40 | |
| | 30 | .551937 | 1.8118010 | .661886 | 1.5108352 | 1.19920 | .833886 | 30 | |
| | 40 | .554360 | 1.8038809 | .666077 | 1.5013282 | 1.20152 | .832277 | 20 | |
| | 50 | .556779 | 1.7960449 | .670285 | 1.4919039 | 1.20386 | .830661 | 10 | |
| 34 | 0 | .559193 | 1.7882916 | .674509 | 1.4825610 | 1.20622 | .829038 | 0 | 5 |
| | 10 | .561602 | 1.7806201 | .678749 | 1.4732983 | 1.20859 | .827407 | 50 | |
| | 20 | .564007 | 1.7730290 | .683007 | 1.4641147 | 1.21099 | .825770 | 40 | |
| | 30 | .566406 | 1.7655173 | .687281 | 1.4550090 | 1.21341 | .824126 | 30 | |
| | 40 | .568801 | 1.7580837 | .691573 | 1.4459801 | 1.21584 | .822475 | 20 | |
| | 50 | .571191 | 1.7507273 | .695881 | 1.4370268 | 1.21830 | .820817 | 10 | |
| 35 | 0 | .573576 | 1.7434468 | .700208 | 1.4281480 | 1.22077 | .819152 | 0 | 5 |
| | 10 | .575957 | 1.7362413 | .704552 | 1.4193427 | 1.22327 | .817480 | 50 | |
| | 20 | .578332 | 1.7291096 | .708913 | 1.4106098 | 1.22579 | .815801 | 40 | |
| | 30 | .580703 | 1.7220508 | .713293 | 1.4019483 | 1.22833 | .814116 | 30 | |
| | 40 | .583069 | 1.7150639 | .717691 | 1.3933571 | 1.23089 | .812423 | 20 | |
| | 50 | .585429 | 1.7081478 | .722108 | 1.3848355 | 1.23347 | .810723 | 10 | |
| 36 | 0 | .587785 | 1.7013016 | .726543 | 1.3763810 | 1.23607 | .809017 | 0 | 5 |
| | 10 | .590136 | 1.6945244 | .730996 | 1.3679959 | 1.23869 | .807304 | 50 | |
| | 20 | .592482 | 1.6878151 | .735469 | 1.3596764 | 1.24134 | .805584 | 40 | |
| | 30 | .594823 | 1.6811730 | .739961 | 1.3514224 | 1.24400 | .803857 | 30 | |
| | 40 | .597159 | 1.6745970 | .744472 | 1.3432331 | 1.24669 | .802123 | 20 | |
| | 50 | .599489 | 1.6680864 | .749003 | 1.3351075 | 1.24940 | .800383 | 10 | |
| 37 | 0 | .601815 | 1.6616401 | .753554 | 1.3270448 | 1.25214 | .798636 | 0 | 5 |
| | 10 | .604136 | 1.6552575 | .758125 | 1.3190441 | 1.25489 | .796882 | 50 | |
| | 20 | .606451 | 1.6489376 | .762716 | 1.3111046 | 1.25767 | .795121 | 40 | |
| | 30 | .608761 | 1.6426796 | .767627 | 1.3032254 | 1.26047 | .793353 | 30 | |
| | 40 | .611067 | 1.6364828 | .771959 | 1.2954057 | 1.26330 | .791579 | 20 | |
| | 50 | .613367 | 1.6303462 | .776612 | 1.2876447 | 1.26615 | .789798 | 10 | |
| 38 | 0 | .615661 | 1.6242692 | .781286 | 1.2799416 | 1.26902 | .788011 | 0 | 5 |
| | 10 | .617951 | 1.6182510 | .785981 | 1.2722957 | 1.27191 | .786217 | 50 | |
| | 20 | .620235 | 1.6122908 | .790698 | 1.2647062 | 1.27483 | .784416 | 40 | |
| | 30 | .622515 | 1.6063879 | .795436 | 1.2571723 | 1.27778 | .782608 | 30 | |
| | 40 | .624789 | 1.6005416 | .800196 | 1.2496933 | 1.28075 | .780794 | 20 | |
| | 50 | .627057 | 1.5947511 | .804080 | 1.2422685 | 1.28374 | .778973 | 10 | 5 |
| ° | ′ | Cosine. | Secant. | Cotangent. | Tangent. | Cosecant. | Sine. | ′ | ° |

*For functions from 51°-10′ to 57°-30′ read from bottom of table upwa*

# NATURAL SINES, COSECANTS, TANGENTS, ETC.

| ° | ′ | Sine. | Cosecant. | Tangent. | Cotangent. | Secant. | Cosine. | ′ | ° |
|---|---|---|---|---|---|---|---|---|---|
| 39 | 0 | .629320 | 1.5890157 | .809784 | 1.2348972 | 1.28676 | .777146 | 0 | 51 |
| | 10 | .631578 | 1.5833318 | .814612 | 1.2275786 | 1.28980 | .775312 | 50 | |
| | 20 | .633831 | 1.5777077 | .819463 | 1.2203121 | 1.29287 | .773472 | 40 | |
| | 30 | .636078 | 1.5721337 | .824336 | 1.2130970 | 1.29597 | .771625 | 30 | |
| | 40 | .638320 | 1.5666121 | .829234 | 1.2059327 | 1.29909 | .769771 | 20 | |
| | 50 | .640557 | 1.5611424 | .834155 | 1.1988184 | 1.30223 | .767911 | 10 | |
| 40 | 0 | .642788 | 1.5557238 | .839100 | 1.1917536 | 1.30541 | .766044 | 0 | 50 |
| | 10 | .645013 | 1.5503558 | .844069 | 1.1847376 | 1.30861 | .764171 | 50 | |
| | 20 | .647233 | 1.5450378 | .849062 | 1.1777698 | 1.31183 | .762292 | 40 | |
| | 30 | .649448 | 1.5397690 | .854081 | 1.1708496 | 1.31509 | .760406 | 30 | |
| | 40 | .651657 | 1.5345491 | .859124 | 1.1639763 | 1.31837 | .758514 | 20 | |
| | 50 | .653861 | 1.5293773 | .864193 | 1.1571495 | 1.32168 | .756615 | 10 | |
| 41 | 0 | .656059 | 1.5242531 | .869287 | 1.1503684 | 1.32501 | .754710 | 0 | 49 |
| | 10 | .658252 | 1.5191759 | .874407 | 1.1436326 | 1.32838 | .752798 | 50 | |
| | 20 | .660439 | 1.5141452 | .879553 | 1.1369414 | 1.33177 | .750880 | 40 | |
| | 30 | .662620 | 1.5091605 | .884725 | 1.1302944 | 1.33519 | .748956 | 30 | |
| | 40 | .664796 | 1.5042211 | .889924 | 1.1236909 | 1.33864 | .747025 | 20 | |
| | 50 | .666966 | 1.4993267 | .895151 | 1.1171305 | 1.34212 | .745088 | 10 | |
| 42 | 0 | .669131 | 1.4944765 | .900404 | 1.1106125 | 1.34563 | .743145 | 0 | 48 |
| | 10 | .671289 | 1.4896703 | .905685 | 1.1041365 | 1.34917 | .741195 | 50 | |
| | 20 | .673443 | 1.4849073 | .910994 | 1.0977020 | 1.35274 | .739239 | 40 | |
| | 30 | .675590 | 1.4801872 | .916331 | 1.0913085 | 1.35634 | .737277 | 30 | |
| | 40 | .677732 | 1.4755095 | .921697 | 1.0849554 | 1.35997 | .735309 | 20 | |
| | 50 | .679868 | 1.4708736 | .927091 | 1.0786423 | 1.36363 | .733335 | 10 | |
| 43 | 0 | .681998 | 1.4662792 | .932515 | 1.0723687 | 1.36733 | .731354 | 0 | 47 |
| | 10 | .684123 | 1.4617257 | .937968 | 1.0661341 | 1.37105 | .729367 | 50 | |
| | 20 | .686242 | 1.4572127 | .943451 | 1.0599381 | 1.37481 | .727374 | 40 | |
| | 30 | .688355 | 1.4527397 | .948965 | 1.0537801 | 1.37860 | .725374 | 30 | |
| | 40 | .690462 | 1.4483063 | .954508 | 1.0476598 | 1.38242 | .723369 | 20 | |
| | 50 | .692563 | 1.4439120 | .960083 | 1.0415767 | 1.38628 | .721357 | 10 | |
| 44 | 0 | .694658 | 1.4395565 | .965689 | 1.0355303 | 1.39016 | .719340 | 0 | 46 |
| | 10 | .696748 | 1.4352393 | .971326 | 1.0295203 | 1.39409 | .717316 | 50 | |
| | 20 | .698832 | 1.4309602 | .976996 | 1.0235461 | 1.39804 | .715286 | 40 | |
| | 30 | .700909 | 1.4267182 | .982697 | 1.0176074 | 1.40203 | .713251 | 30 | |
| | 40 | .702981 | 1.4225134 | .988432 | 1.0117088 | 1.40606 | .711209 | 20 | |
| | 50 | .705047 | 1.4183454 | .994199 | 1.0058348 | 1.41012 | .709161 | 10 | |
| 45 | 0 | .707107 | 1.4142136 | 1.000000 | 1.0000030 | 1.41421 | .707107 | 0 | 45 |
| ° | ′ | Cosine. | Secant. | Cotangent. | Tangent. | Cosecant. | Sine. | ′ | ° |

For functions from 45°-0′ to 51°-0′ read from bottom of table upward.

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS AND RECIPROCALS.

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1.0000000 | 1.0000000 | 1.000000000 |
| 2 | 4 | 8 | 1.4142136 | 1.2599210 | .500000000 |
| 3 | 9 | 27 | 1.7320508 | 1.4422496 | .333333333 |
| 4 | 16 | 64 | 2.0000000 | 1.5874011 | .250000000 |
| 5 | 25 | 125 | 2.2360680 | 1.7099759 | .200000000 |
| 6 | 36 | 216 | 2.4494897 | 1.8171206 | .166666667 |
| 7 | 49 | 343 | 2.6457513 | 1.9129312 | .142857143 |
| 8 | 64 | 512 | 2.8284271 | 2.0000000 | .125000000 |
| 9 | 81 | 729 | 3.0000000 | 2.0800837 | .111111111 |
| | 100 | 1000 | 3.1622777 | 2.1544347 | .100000000 |
| | 121 | 1331 | 3.3166248 | 2.2239801 | .090909091 |
| | 144 | 1728 | 3.4641016 | 2.2894286 | .083333333 |
| | 169 | 2197 | 3.6055513 | 2.3513347 | .076923077 |
| | 196 | 2744 | 3.7416574 | 2.4101422 | .071428571 |
| | 225 | 3375 | 3.8729833 | 2.4662121 | .066666667 |
| | 256 | 4096 | 4.0000000 | 2.5198421 | .062500000 |
| | 289 | 4913 | 4.1231056 | 2.5712816 | .058823529 |
| | 324 | 5832 | 4.2426407 | 2.6207414 | .055555556 |
| | 361 | 6859 | 4.3588989 | 2.6684016 | .052631579 |
| | 400 | 8000 | 4.4721360 | 2.7144177 | .050000000 |
| | 441 | 9261 | 4.5825757 | 2.7589243 | .047619048 |
| | 484 | 10648 | 4.6904158 | 2.8020393 | .045454545 |
| | 529 | 12167 | 4.7958315 | 2.8438670 | .043478261 |
| | 576 | 13824 | 4.8989795 | 2.8844991 | .041666667 |
| | 625 | 15625 | 5.0000000 | 2.9240177 | .040000000 |
| | 676 | 17576 | 5.0990195 | 2.9624960 | .038461538 |
| | 729 | 19683 | 5.1961524 | 3.0000000 | .037037037 |
| | 784 | 21952 | 5.2915026 | 3.0365889 | .035714286 |
| | 841 | 24389 | 5.3851648 | 3.0723168 | .034482759 |
| | 900 | 27000 | 5.4772256 | 3.1072325 | .033333333 |
| | 961 | 29791 | 5.5677644 | 3.1413806 | .032258065 |
| | 1024 | 32768 | 5.6568542 | 3.1748021 | .031250000 |
| | 1089 | 35937 | 5.7445626 | 3.2075343 | .030303030 |
| | 1156 | 39304 | 5.8309519 | 3.2396118 | .029411765 |
| | 1225 | 42875 | 5.9160798 | 3.2710663 | .028571429 |
| | 1296 | 46656 | 6.0000000 | 3.3019272 | .027777778 |
| | 1369 | 50653 | 6.0827625 | 3.3322218 | .027027027 |
| | 1444 | 54872 | 6.1644140 | 3.3619754 | .026315789 |
| | 1521 | 59319 | 6.2449980 | 3.3912114 | .025641026 |
| | 1600 | 64000 | 6.3245553 | 3.4199519 | .025000000 |
| | 1681 | 68921 | 6.4031242 | 3.4482172 | .024390244 |
| | 1764 | 74088 | 6.4807407 | 3.4760266 | .023809524 |
| | 1849 | 79507 | 6.5574385 | 3.5033981 | .023255814 |
| | 1936 | 85184 | 6.6332496 | 3.5303483 | .022727273 |
| | 2025 | 91125 | 6.7082039 | 3.5568933 | .022222222 |
| | 2116 | 97336 | 6.7823300 | 3.5830479 | .021739130 |
| | 2209 | 103823 | 6.8556546 | 3.6088261 | .021276600 |
| | 2304 | 110592 | 6.9282032 | 3.6342411 | .020833333 |
| | 2401 | 117649 | 7.0000000 | 3.6593057 | .020408163 |
| | 2500 | 125000 | 7.0710678 | 3.6840314 | .020000000 |
| | 2601 | 132651 | 7.1414284 | 3.7084298 | .019607843 |
| | 2704 | 140608 | 7.2111026 | 3.7325111 | .019230769 |
| | 2809 | 148877 | 7.2801099 | 3.7562858 | .018867925 |
| | 2916 | 157464 | 7.3484692 | 3.7797631 | .018518519 |
| | 3025 | 166375 | 7.4161985 | 3.8029525 | .018181818 |
| | 3136 | 175616 | 7.4833148 | 3.8258624 | .017857143 |
| 57 | 3249 | 185193 | 7.5498344 | 3.8485011 | .017543860 |
| 58 | 3364 | 195112 | 7.6157731 | 3.8708766 | .017241379 |
| 59 | 3481 | 205379 | 7.6811457 | 3.8929965 | .016949153 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, AND RECIPROCALS.

| No. | Square. | Square Root. | Cube Root. | Reciprocal. |
|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS AND RECIPROCALS.

| Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|
| 14400 | 1728000 | 10.9544512 | 4.9324242 | .008333333 |
| 14641 | 1771561 | 11.0000000 | 4.9460874 | .008264463 |
| 14884 | 1815848 | 11.0453610 | 4.9596757 | .008196721 |
| 15129 | 1860867 | 11.0905365 | 4.9731898 | .008130081 |
| 15376 | 1906624 | 11.1355287 | 4.9866310 | .008064516 |
| 15625 | 1953125 | 11.1803399 | 5.0000000 | .008000000 |
| 15876 | 2000376 | 11.2249722 | 5.0132979 | .007936508 |
| 16129 | 2048383 | 11.2694277 | 5.0265257 | .007874016 |
| 16384 | 2097152 | 11.3137085 | 5.0396842 | .007812500 |
| 16641 | 2146689 | 11.3578167 | 5.0527743 | .007751938 |
| 16900 | 2197000 | 11.4017543 | 5.0657970 | .007692308 |
| 17161 | 2248091 | 11.4455231 | 5.0787531 | .007633588 |
| 17424 | 2299968 | 11.4891253 | 5.0916434 | .007575758 |
| 17689 | 2352637 | 11.5325626 | 5.1044687 | .007518797 |
| 17956 | 2406104 | 11.5758369 | 5.1172299 | .007462687 |
| 18225 | 2460375 | 11.6189500 | 5.1299278 | .007407407 |
| 18496 | 2515456 | 11.6619038 | 5.1425632 | .007352941 |
| 18769 | 2571353 | 11.7046999 | 5.1551367 | .007299270 |
| 19044 | 2628072 | 11.7473401 | 5.1676493 | .007246377 |
| 19321 | 2685619 | 11.7898261 | 5.1801015 | .007194245 |
| 19600 | 2744000 | 11.8321596 | 5.1924941 | .007142857 |
| 19881 | 2803221 | 11.8743421 | 5.2048279 | .007092199 |
| 20164 | 2863288 | 11.9163753 | 5.2171034 | .007042254 |
| 20449 | 2924207 | 11.9582607 | 5.2293215 | .006993007 |
| 20736 | 2985984 | 12.0000000 | 5.2414828 | .006944444 |
| 21025 | 3048625 | 12.0415946 | 5.2535879 | .006896552 |
| 21316 | 3112136 | 12.0830460 | 5.2656374 | .006849315 |
| 21609 | 3176523 | 12.1243557 | 5.2776321 | .006802721 |
| 21904 | 3241792 | 12.1655251 | 5.2895725 | .006756757 |
| 22201 | 3307949 | 12.2065556 | 5.3014592 | .006711409 |
| 22500 | 3375000 | 12.2474487 | 5.3132928 | .006666667 |
| 22801 | 3442951 | 12.2882057 | 5.3250740 | .006622517 |
| 23104 | 3511808 | 12.3288280 | 5.3368033 | .006578947 |
| 23409 | 3581577 | 12.3693169 | 5.3484812 | .006535948 |
| 23716 | 3652264 | 12.4096736 | 5.3601084 | .006493506 |
| 24025 | 3723875 | 12.4498996 | 5.3716854 | .006451613 |
| 24336 | 3796416 | 12.4899960 | 5.3832126 | .006410256 |
| 24649 | 3869893 | 12.5299641 | 5.3946907 | .006369427 |
| 24964 | 3944312 | 12.5698051 | 5.4061202 | .006329114 |
| 25281 | 4019679 | 12.6095202 | 5.4175015 | .006289308 |
| 25600 | 4096000 | 12.6491106 | 5.4288352 | .006250000 |
| 25921 | 4173281 | 12.6885775 | 5.4401218 | .006211180 |
| 26244 | 4251528 | 12.7279221 | 5.4513618 | .006172840 |
| 26569 | 4330747 | 12.7671453 | 5.4625556 | .006134969 |
| 26896 | 4410944 | 12.8062485 | 5.4737037 | .006097561 |
| 27225 | 4492125 | 12.8452326 | 5.4848066 | .006060606 |
| 27556 | 4574296 | 12.8840987 | 5.4958647 | .006024096 |
| 27889 | 4657463 | 12.9228480 | 5.5068784 | .005988024 |
| 28224 | 4741632 | 12.9614814 | 5.5178484 | .005952381 |
| 28561 | 4826809 | 13.0000000 | 5.5287748 | .005917160 |
| 28900 | 4913000 | 13.0384048 | 5.5396583 | .005882353 |
| 29241 | 5000211 | 13.0766968 | 5.5504991 | .005847953 |
| 29584 | 5088448 | 13.1148770 | 5.5612978 | .005813953 |
| 29929 | 5177717 | 13.1529464 | 5.5720546 | .005780347 |
| 30276 | 5268024 | 13.1909060 | 5.5827702 | .005747126 |
| 30625 | 5359375 | 13.2287566 | 5.5934447 | .005714286 |
| 30976 | 5451776 | 13.2664992 | 5.6040787 | .00568181[illegible] |
| 31329 | 5545233 | 13.3041347 | 5.6146724 | [illegible] |
| 31684 | 5639752 | 13.3416641 | 5.6252263 | [illegible] |
| 32041 | 5735339 | 13.3790882 | 5.6357408 | [illegible] |

## SQUARES, CUBES, SQUARE ROOTS CUBE ROOTS AND RECIPROCALS.

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. |
|---|---|---|---|---|
| 180 | 32400 | 5832000 | 13.4164079 | 5.6462162 |
| 181 | 32761 | 5929741 | 13.4536240 | 5.6566528 |
| 182 | 33124 | 6028568 | 13.4907376 | 5.6670511 |
| 183 | 33489 | 6128487 | 13.5277493 | 5.6774114 |
| 184 | 33856 | 6229504 | 13.5646600 | 5.6877340 |
| 185 | 34225 | 6331625 | 13.6014705 | 5.6980192 |
| 186 | 34596 | 6434856 | 13.6381817 | 5.7082675 |
| 187 | 34969 | 6539203 | 13.6747943 | 5.7184791 |
| 188 | 35344 | 6644672 | 13.7113092 | 5.7286543 |
| 189 | 35721 | 6751269 | 13.7477271 | 5.7387936 |
| 190 | 36100 | 6859000 | 13.7840488 | 5.7488971 |
| 191 | 36481 | 6967871 | 13.8202750 | 5.7589652 |
| 192 | 36864 | 7077888 | 13.8564065 | 5.7689982 |
| 193 | 37249 | 7189057 | 13.8924440 | 5.7789966 |
| 194 | 37636 | 7301384 | 13.9283883 | 5.7889604 |
| 195 | 38025 | 7414875 | 13.9642400 | 5.7988900 |
| 196 | 38416 | 7529536 | 14.0000000 | 5.8087857 |
| 197 | 38809 | 7645373 | 14.0356688 | 5.8186479 |
| 198 | 39204 | 7762392 | 14.0712473 | 5.8284767 |
| 199 | 39601 | 7880599 | 14.1067360 | 5.8382725 |
| 200 | 40000 | 8000000 | 14.1421356 | 5.8480355 |
| 201 | 40401 | 8120601 | 14.1774469 | 5.8577660 |
| 202 | 40804 | 8242408 | 14.2126704 | 5.8674643 |
| 203 | 41209 | 8365427 | 14.2478068 | 5.8771307 |
| 204 | 41616 | 8489664 | 14.2828569 | 5.8867653 |
| 205 | 42025 | 8615125 | 14.3178211 | 5.8963685 |
| 206 | 42436 | 8741816 | 14.3527001 | 5.9059406 |
| 207 | 42849 | 8869743 | 14.3874946 | 5.9154817 |
| 208 | 43264 | 8998912 | 14.4222051 | 5.9249921 |
| 209 | 43681 | 9129329 | 14.4568323 | 5.9344721 |
| 210 | 44100 | 9261000 | 14.4913767 | 5.9439220 |
| 211 | 44521 | 9393931 | 14.5258390 | 5.9533418 |
| 212 | 44944 | 9528128 | 14.5602198 | 5.9627320 |
| 213 | 45369 | 9663597 | 14.5945195 | 5.9720926 |
| 214 | 45796 | 9800344 | 14.6287388 | 5.9814240 |
| 215 | 46225 | 9938375 | 14.6628783 | 5.9907264 |
| 216 | 46656 | 10077696 | 14.6969385 | 6.0000000 |
| 217 | 47089 | 10218313 | 14.7309199 | 6.0092450 |
| 218 | 47524 | 10360232 | 14.7648231 | 6.0184617 |
| 219 | 47961 | 10503459 | 14.7986486 | 6.0276502 |
| 220 | 48400 | 10648000 | 14.8323970 | 6.0368107 |
| 221 | 48841 | 10793861 | 14.8660687 | 6.0459435 |
| 222 | 49284 | 10941048 | 14.8996644 | 6.0550489 |
| 223 | 49729 | 11089567 | 14.9331845 | 6.0641270 |
| 224 | 50176 | 11239424 | 14.9666295 | 6.0731779 |
| 225 | 50625 | 11390625 | 15.0000000 | 6.0822020 |
| 226 | 51076 | 11543176 | 15.0332964 | 6.0911994 |
| 227 | 51529 | 11697083 | 15.0665192 | 6.1001702 |
| 228 | 51984 | 11852352 | 15.0996689 | 6.1091147 |
| 229 | 52441 | 12008989 | 15.1327460 | 6.1180332 |
| 230 | 52900 | 12167000 | 15.1657509 | 6.1269257 |
| 231 | 53361 | 12326391 | 15.1986842 | 6.1357924 |
| 232 | 53824 | 12487168 | 15.2315462 | 6.1446337 |
| 233 | 54289 | 12649337 | 15.2643375 | 6.1534495 |
| 234 | 54756 | 12812904 | 15.2970585 | 6.1622401 |
| 235 | 55225 | 12977875 | 15.3297097 | 6.1710058 |
| 236 | 55696 | 13144256 | 15.3622915 | 6.1797466 |
| 237 | 56169 | 13312053 | 15.3948043 | 6.1884625 |
| 238 | 56644 | 13481272 | 15.4272486 | 6.1971544 |
| 239 | 57121 | 13651919 | 15.4596248 | 6.2058218 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS AND RECIPROCALS.

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|---|
| 240 | 57600 | 13824000 | 15.4919334 | 6.2144650 | .004166667 |
| 241 | 58081 | 13997521 | 15.5241747 | 6.2230843 | .004149378 |
| 242 | 58564 | 14172488 | 15.5563492 | 6.2316797 | .004132231 |
| 243 | 59049 | 14348907 | 15.5884573 | 6.2402515 | .004115226 |
| 244 | 59536 | 14526784 | 15.6204994 | 6.2487998 | .004098361 |
| 245 | 60025 | 14706125 | 15.6524758 | 6.2573248 | .004081633 |
| 246 | 60516 | 14886936 | 15.6843871 | 6.2658266 | .004065041 |
| 247 | 61009 | 15069223 | 15.7162336 | 6.2743054 | .004048583 |
| 248 | 61504 | 15252992 | 15.7480157 | 6.2827613 | .004032258 |
| 249 | 62001 | 15438249 | 15.7797338 | 6.2911946 | .004016064 |
| 250 | 62500 | 15625000 | 15.8113883 | 6.2996053 | .004000000 |
| 251 | 63001 | 15813251 | 15.8429795 | 6.3079935 | .003984064 |
| 252 | 63504 | 16003008 | 15.8745079 | 6.3163596 | .003968254 |
| 253 | 64009 | 16194277 | 15.9059737 | 6.3247035 | .003952569 |
| 254 | 64516 | 16387064 | 15.9373775 | 6.3330256 | .003937008 |
| 255 | 65025 | 16581375 | 15.9687194 | 6.3413257 | .003921569 |
| 256 | 65536 | 16777216 | 16.0000000 | 6.3496042 | .003906250 |
| 257 | 66049 | 16974593 | 16.0312195 | 6.3578611 | .003891051 |
| 258 | 66564 | 17173512 | 16.0623784 | 6.3660968 | .003875969 |
| 259 | 67081 | 17373979 | 16.0934769 | 6.3743111 | .003861004 |
| 260 | 67600 | 17576000 | 16.1245155 | 6.3825043 | .003846154 |
| 261 | 68121 | 17779581 | 16.1554944 | 6.3906765 | .003831418 |
| 262 | 68644 | 17984728 | 16.1864141 | 6.3988279 | .003816794 |
| 263 | 69169 | 18191447 | 16.2172747 | 6.4069585 | .003802281 |
| 264 | 69696 | 18399744 | 16.2480768 | 6.4150687 | .003787879 |
| 265 | 70225 | 18609625 | 16.2788206 | 6.4231583 | .003773585 |
| 266 | 70756 | 18821096 | 16.3095064 | 6.4312276 | .003759398 |
| 267 | 71289 | 19034163 | 16.3401346 | 6.4392767 | .003745318 |
| 268 | 71824 | 19248832 | 16.3707055 | 6.4473057 | .003731343 |
| 269 | 72361 | 19465109 | 16.4012195 | 6.4553148 | .003717472 |
| 270 | 72900 | 19683000 | 16.4316767 | 6.4633041 | .003703704 |
| 271 | 73441 | 19902511 | 16.4620776 | 6.4712736 | .003690037 |
| 272 | 73984 | 20123648 | 16.4924225 | 6.4792236 | .003676471 |
| 273 | 74529 | 20346417 | 16.5227116 | 6.4871541 | .003663004 |
| 274 | 75076 | 20570824 | 16.5529454 | 6.4950653 | .003649635 |
| 275 | 75625 | 20796875 | 16.5831240 | 6.5029572 | .003636364 |
| 276 | 76176 | 21024576 | 16.6132477 | 6.5108300 | .003623188 |
| 277 | 76729 | 21253933 | 16.6433170 | 6.5186839 | .003610108 |
| 278 | 77284 | 21484952 | 16.6733320 | 6.5265189 | .003597122 |
| 279 | 77841 | 21717639 | 16.7032931 | 6.5343351 | .003584229 |
| 280 | 78400 | 21952000 | 16.7332005 | 6.5421326 | .003571429 |
| 281 | 78961 | 22188041 | 16.7630546 | 6.5499116 | .003558719 |
| 282 | 79524 | 22425768 | 16.7928556 | 6.5576722 | .003546099 |
| 283 | 80089 | 22665187 | 16.8226038 | 6.5654144 | .003533569 |
| 284 | 80656 | 22906304 | 16.8522995 | 6.5731385 | .003521127 |
| 285 | 81225 | 23149125 | 16.8819430 | 6.5808443 | .003508772 |
| 286 | 81796 | 23393656 | 16.9115345 | 6.5885323 | .003496503 |
| 287 | 82369 | 23639903 | 16.9410743 | 6.5962023 | .003484321 |
| 288 | 82944 | 23887872 | 16.9705627 | 6.6038545 | .003472222 |
| 289 | 83521 | 24137569 | 17.0000000 | 6.6114890 | .003460208 |
| 290 | 84100 | 24389000 | 17.0293864 | 6.6191060 | .003448276 |
| 291 | 84681 | 24642171 | 17.0587221 | 6.6267054 | .003436426 |
| 292 | 85264 | 24897088 | 17.0880075 | 6.6342874 | .003424658 |
| 293 | 85849 | 25153757 | 17.1172428 | 6.6418522 | .003412969 |
| 294 | 86436 | 25412184 | 17.1464282 | 6.6493998 | .003401361 |
| 295 | 87025 | 25672375 | 17.1755640 | 6.6569302 | .003389831 |
| 296 | *87616* | 25934336 | 17.2046505 | 6.6644437 | .003378378 |
| 297 | *88209* | 26198073 | 17.2336879 | 6.6719403 | .003367003 |
| 298 | *88804* | 26463592 | 17.2626765 | 6.6794200 | .003355705 |
| 299 | *89401* | 26730899 | 17.2916165 | 6.6868831 | .003344482 |

# SQUARES, CUBES, SQUARE ROO
# CUBE ROOTS AND RECIPROCA

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. |
|---|---|---|---|---|
| 300 | 90000 | 27000000 | 17.3205081 | 6.6943295 |
| 301 | 90601 | 27270901 | 17.3493516 | 6.7017598 |
| 302 | 91204 | 27543608 | 17.3781472 | 6.7091729 |
| 303 | 91809 | 27818127 | 17.4068952 | 6.7165700 |
| 304 | 92416 | 28094464 | 17.4355958 | 6.7239508 |
| 305 | 93025 | 28372625 | 17.4642492 | 6.7313155 |
| 306 | 93636 | 28652616 | 17.4928557 | 6.7386641 |
| 307 | 94249 | 28934443 | 17.5214155 | 6.7459967 |
| 308 | 94864 | 29218112 | 17.5499288 | 6.7533134 |
| 309 | 95481 | 29503629 | 17.5783958 | 6.7606143 |
| 310 | 96100 | 29791000 | 17.6068169 | 6.7678995 |
| 311 | 96721 | 30080231 | 17.6351921 | 6.7751690 |
| 312 | 97344 | 30371328 | 17.6635217 | 6.7824229 |
| 313 | 97969 | 30664297 | 17.6918060 | 6.7896613 |
| 314 | 98596 | 30959144 | 17.7200451 | 6.7968844 |
| 315 | 99225 | 31255875 | 17.7482393 | 6.8040921 |
| 316 | 99856 | 31554496 | 17.7763888 | 6.8112847 |
| 317 | 100489 | 31855013 | 17.8044938 | 6.8184620 |
| 318 | 101124 | 32157432 | 17.8325545 | 6.8256242 |
| 319 | 101761 | 32461759 | 17.8605711 | 6.8327714 |
| 320 | 102400 | 32768000 | 17.8885438 | 6.8399037 |
| 321 | 103041 | 33076161 | 17.9164729 | 6.8470213 |
| 322 | 103684 | 33386248 | 17.9443584 | 6.8541240 |
| 323 | 104329 | 33698267 | 17.9722008 | 6.8612120 |
| 324 | 104976 | 34012224 | 18.0000000 | 6.8682855 |
| 325 | 105625 | 34328125 | 18.0277564 | 6.8753443 |
| 326 | 106276 | 34645976 | 18.0554701 | 6.8823888 |
| 327 | 106929 | 34965783 | 18.0831413 | 6.8894188 |
| 328 | 107584 | 35287552 | 18.1107703 | 6.8964345 |
| 329 | 108241 | 35611289 | 18.1383571 | 6.9034359 |
| 330 | 108900 | 35937000 | 18.1659021 | 6.9104232 |
| 331 | 109561 | 36264691 | 18.1934054 | 6.9173964 |
| 332 | 110224 | 36594368 | 18.2208672 | 6.9243556 |
| 333 | 110889 | 36926037 | 18.2482876 | 6.9313008 |
| 334 | 111556 | 37259704 | 18.2756669 | 6.9382321 |
| 335 | 112225 | 37595875 | 18.3030052 | 6.9451496 |
| 336 | 112896 | 37933056 | 18.3303028 | 6.9520533 |
| 337 | 113569 | 38272753 | 18.3575598 | 6.9589434 |
| 338 | 114244 | 38614472 | 18.3847763 | 6.9658198 |
| 339 | 114921 | 38958219 | 18.4119526 | 6.9726826 |
| 340 | 115600 | 39304000 | 18.4390889 | 6.9795321 |
| 341 | 116281 | 39651821 | 18.4661853 | 6.9863681 |
| 342 | 116964 | 40001688 | 18.4932420 | 6.9931906 |
| 343 | 117649 | 40353607 | 18.5202592 | 7.0000000 |
| 344 | 118336 | 40707584 | 18.5472370 | 7.0067962 |
| 345 | 119025 | 41063625 | 18.5741756 | 7.0135791 |
| 346 | 119716 | 41421736 | 18.6010752 | 7.0203490 |
| 347 | 120409 | 41781923 | 18.6279360 | 7.0271058 |
| 348 | 121104 | 42144192 | 18.6547581 | 7.0338497 |
| 349 | 121801 | 42508549 | 18.6815417 | 7.0405806 |
| 350 | 122500 | 42875000 | 18.7082869 | 7.0472987 |
| 351 | 123201 | 43243551 | 18.7349940 | 7.0540041 |
| 352 | 123904 | 43614208 | 18.7616630 | 7.0606967 |
| 353 | 124609 | 43986977 | 18.7882942 | 7.0673767 |
| 354 | 125316 | 44361864 | 18.8148877 | 7.0740440 |
| 355 | 126025 | 44738875 | 18.8414437 | 7.0806988 |
| 356 | 126736 | 45118016 | 18.8679623 | 7.0873411 |
| 357 | 127449 | 45499293 | 18.8944436 | 7.0939709 |
| 358 | 128164 | 45882712 | 18.9208879 | 7.1005885 |
| | 128881 | 46268279 | 18.9472953 | 7.1071939 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS AND RECIPROCALS.

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|---|
| 360 | 129600 | 46656000 | 18.9736660 | 7.1137866 | .002777778 |
| 361 | 130321 | 47045881 | 19.0000000 | 7.1203674 | .002770083 |
| 362 | 131044 | 47437928 | 19.0262976 | 7.1269360 | .002762431 |
| 363 | 131769 | 47832147 | 19.0525589 | 7.1334925 | .002754821 |
| 364 | 132496 | 48228544 | 19.0787840 | 7.1400370 | .002747253 |
| 365 | 133225 | 48627125 | 19.1049732 | 7.1465695 | .002739726 |
| 366 | 133956 | 49027896 | 19.1311265 | 7.1530901 | .002732240 |
| 367 | 134689 | 49430863 | 19.1572441 | 7.1595988 | .002724796 |
| 368 | 135424 | 49836032 | 19.1833261 | 7.1660957 | .002717391 |
| 369 | 136161 | 50243409 | 19.2093727 | 7.1725809 | .002710027 |
| 370 | 136900 | 50653000 | 19.2353841 | 7.1790544 | .002702703 |
| 371 | 137641 | 51064811 | 19.2613603 | 7.1855162 | .002695418 |
| 372 | 138384 | 51478848 | 19.2873015 | 7.1919663 | .002688172 |
| 373 | 139129 | 51895117 | 19.3132079 | 7.1984050 | .002680965 |
| 374 | 139876 | 52313624 | 19.3390796 | 7.2048322 | .002673797 |
| 375 | 140625 | 52734375 | 19.3649167 | 7.2112479 | .002666667 |
| 376 | 141376 | 53157376 | 19.3907194 | 7.2176522 | .002659574 |
| 377 | 142129 | 53582633 | 19.4164878 | 7.2240450 | .002652520 |
| 378 | 142884 | 54010152 | 19.4422221 | 7.2304268 | .002645503 |
| 379 | 143641 | 54439939 | 19.4679223 | 7.2367972 | .002638522 |
| 380 | 144400 | 54872000 | 19.4935887 | 7.2431565 | .002631579 |
| 381 | 145161 | 55306341 | 19.5192213 | 7.2495045 | .002624672 |
| 382 | 145924 | 55742968 | 19.5448203 | 7.2558415 | .002617801 |
| 383 | 146689 | 56181887 | 19.5703858 | 7.2621675 | .002610966 |
| 384 | 147456 | 56623104 | 19.5959179 | 7.2684824 | .002604167 |
| 385 | 148225 | 57066625 | 19.6214169 | 7.2747864 | .002597403 |
| 386 | 148996 | 57512456 | 19.6468827 | 7.2810794 | .002590674 |
| 387 | 149769 | 57960603 | 19.6723156 | 7.2873617 | .002583979 |
| 388 | 150544 | 58411072 | 19.6977156 | 7.2936330 | .002577320 |
| 389 | 151321 | 58863869 | 19.7230829 | 7.2998936 | .002570694 |
| 390 | 152100 | 59319000 | 19.7484177 | 7.3061436 | .002564103 |
| 391 | 152881 | 59776471 | 19.7737199 | 7.3123828 | .002557545 |
| 392 | 153664 | 60236288 | 19.7989899 | 7.3186114 | .002551020 |
| 393 | 154449 | 60698457 | 19.8242276 | 7.3248295 | .002544529 |
| 394 | 155236 | 61162984 | 19.8494332 | 7.3310369 | .002538071 |
| 395 | 156025 | 61629875 | 19.8746069 | 7.3372339 | .002531646 |
| 396 | 156816 | 62099136 | 19.8997487 | 7.3434205 | .002525253 |
| 397 | 157609 | 62570773 | 19.9248588 | 7.3495966 | .002518892 |
| 398 | 158404 | 63044792 | 19.9499373 | 7.3557624 | .002512563 |
| 399 | 159201 | 63521199 | 19.9749844 | 7.3619178 | .002506266 |
| 400 | 160000 | 64000000 | 20.0000000 | 7.3680630 | .002500000 |
| 401 | 160801 | 64481201 | 20.0249844 | 7.3741979 | .002493766 |
| 402 | 161604 | 64964808 | 20.0499377 | 7.3803227 | .002487562 |
| 403 | 162409 | 65450827 | 20.0748599 | 7.3864373 | .002481390 |
| 404 | 163216 | 65939264 | 20.0997512 | 7.3925418 | .002475248 |
| 405 | 164025 | 66430125 | 20.1246118 | 7.3986363 | .002469136 |
| 406 | 164836 | 66923416 | 20.1494417 | 7.4047206 | .002463054 |
| 407 | 165649 | 67419143 | 20.1742410 | 7.4107950 | .002457002 |
| 408 | 166464 | 67917312 | 20.1990099 | 7.4168595 | .002450980 |
| 409 | 167281 | 68417929 | 20.2237484 | 7.4229142 | .002444988 |
| 410 | 168100 | 68921000 | 20.2484567 | 7.4289589 | .002439024 |
| 411 | 168921 | 69426531 | 20.2731349 | 7.4349938 | .002433090 |
| 412 | 169744 | 69934528 | 20.2977831 | 7.4410189 | .002427184 |
| 413 | 170569 | 70444997 | 20.3224014 | 7.4470342 | .002421308 |
| 414 | 171396 | 70957944 | 20.3469899 | 7.4530399 | .002415459 |
| 415 | 172225 | 71473375 | 20.3715488 | 7.4590359 | .002409639 |
| 416 | 173056 | 71991296 | 20.3960781 | 7.4650223 | .002403846 |
| 417 | 173889 | 72511713 | 20.4205779 | 7.4709991 | .002398082 |
| *418* | *174724* | 73034632 | 20.4450483 | 7.4769664 | .002392344 |
| *419* | *175561* | 73560059 | 20.4694895 | 7.4829242 | .002386634 |

## SQUARES, CUBES, SQUARE ROOTS AND CUBE ROOTS AND RECIPRO

| No. | Squares. | Cubes. | Square Roots. | Cube R |
|---|---|---|---|---|
| 420 | 176400 | 74088000 | 20.4939015 | 7.48 |
| 421 | 177241 | 74618461 | 20.5182845 | 7.49 |
| 422 | 178084 | 75151448 | 20.5426386 | 7.50 |
| 423 | 178929 | 75686967 | 20.5669638 | 7.50 |
| 424 | 179776 | 76225024 | 20.5912603 | 7.51 |
| 425 | 180625 | 76765625 | 20.6155281 | 7.51 |
| 426 | 181476 | 77308776 | 20.6397674 | 7.52 |
| 427 | 182329 | 77854483 | 20.6639783 | 7.53 |
| 428 | 183184 | 78402752 | 20.6881609 | 7.53 |
| 429 | 184041 | 78953589 | 20.7123152 | 7.54 |
| 430 | 184900 | 79507000 | 20.7364414 | 7.54 |
| 431 | 185761 | 80062991 | 20.7605395 | 7.55 |
| 432 | 186624 | 80621568 | 20.7846097 | 7.55 |
| 433 | 187489 | 81182737 | 20.8086520 | 7.56 |
| 434 | 188356 | 81746504 | 20.8326667 | 7.57 |
| 435 | 189225 | 82312875 | 20.8566536 | 7.57 |
| 436 | 190096 | 82881856 | 20.8806130 | 7.58 |
| 437 | 190969 | 83453453 | 20.9045450 | 7.58 |
| 438 | 191844 | 84027672 | 20.9284495 | 7.59 |
| 439 | 192721 | 84604519 | 20.9523268 | 7.60 |
| 440 | 193600 | 85184000 | 20.9761770 | 7.60 |
| 441 | 194481 | 85766121 | 21.0000000 | 7.61 |
| 442 | 195364 | 86350888 | 21.0237960 | 7.61 |
| 443 | 196249 | 86938307 | 21.0475652 | 7.62 |
| 444 | 197136 | 87528384 | 21.0713075 | 7.62 |
| 445 | 198025 | 88121125 | 21.0950231 | 7.63 |
| 446 | 198916 | 88716536 | 21.1187121 | 7.64 |
| 447 | 199809 | 89314623 | 21.1423745 | 7.64 |
| 448 | 200704 | 89915392 | 21.1660105 | 7.65 |
| 449 | 201601 | 90518849 | 21.1896201 | 7.65 |
| 450 | 202500 | 91125000 | 21.2132034 | 7.66 |
| 451 | 203401 | 91733851 | 21.2367606 | 7.66 |
| 452 | 204304 | 92345408 | 21.2602916 | 7.67 |
| 453 | 205209 | 92959677 | 21.2837967 | 7.68 |
| 454 | 206116 | 93576664 | 21.3072758 | 7.68 |
| 455 | 207025 | 94196375 | 21.3307290 | 7.69 |
| 456 | 207936 | 94818816 | 21.3541565 | 7.69 |
| 457 | 208849 | 95443993 | 21.3775583 | 7.70 |
| 458 | 209764 | 96071912 | 21.4009346 | 7.70 |
| 459 | 210681 | 96702579 | 21.4242853 | 7.71 |
| 460 | 211600 | 97336000 | 21.4476106 | 7.71 |
| 461 | 212521 | 97972181 | 21.4709106 | 7.72 |
| 462 | 213444 | 98611128 | 21.4941853 | 7.73 |
| 463 | 214369 | 99252847 | 21.5174348 | 7.73 |
| 464 | 215296 | 99897344 | 21.5406592 | 7.74 |
| 465 | 216225 | 100544625 | 21.5638587 | 7.74 |
| 466 | 217156 | 101194696 | 21.5870331 | 7.75 |
| 467 | 218089 | 101847563 | 21.6101828 | 7.75 |
| 468 | 219024 | 102503232 | 21.6333077 | 7.76 |
| 469 | 219961 | 103161709 | 21.6564078 | 7.76 |
| 470 | 220900 | 103823000 | 21.6794834 | 7.77 |
| 471 | 221841 | 104487111 | 21.7025344 | 7.78 |
| 472 | 222784 | 105154048 | 21.7255610 | 7.78 |
| 473 | 223729 | 105823817 | 21.7485632 | 7.79 |
| 474 | 224676 | 106496424 | 21.7715411 | 7.79 |
| 475 | 225625 | 107171875 | 21.7944947 | 7.80 |
| 476 | 226576 | 107850176 | 21.8174242 | 7.80 |
| | 227529 | 108531333 | 21.8403297 | 7.81 |
| | 228484 | 109215352 | 21.8632111 | 7.8 |
| | 229441 | 109902239 | 21.8860686 | 7.8 |

# ARES, CUBES, SQUARE ROOTS, BE ROOTS AND RECIPROCALS.

| es. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|
| 400 | 110592000 | 21.9089023 | 7.8297353 | .002083333 |
| 361 | 111284641 | 21.9317122 | 7.8351688 | .002079002 |
| 324 | 111980168 | 21.9544984 | 7.8405949 | .002074689 |
| 289 | 112678587 | 21.9772610 | 7.8460134 | .002070393 |
| 256 | 113379904 | 22.0000000 | 7.8514244 | .002066116 |
| 225 | 114084125 | 22.0227155 | 7.8568281 | .002061856 |
| 196 | 114791256 | 22.0454077 | 7.8622242 | .002057613 |
| 169 | 115501303 | 22.0680765 | 7.8676130 | .002053388 |
| 144 | 116214272 | 22.0907220 | 7.8729944 | .002049180 |
| 121 | 116930169 | 22.1133444 | 7.8783684 | .002044990 |
| 100 | 117649000 | 22.1359436 | 7.8837352 | .002040816 |
| 081 | 118370771 | 22.1585198 | 7.8890946 | .002036660 |
| 064 | 119095488 | 22.1810730 | 7.8944468 | .002032520 |
| 049 | 119823157 | 22.2036033 | 7.8997917 | .002028398 |
| 036 | 120553784 | 22.2261108 | 7.9051294 | .002024291 |
| 025 | 121287375 | 22.2485955 | 7.9104599 | .002020202 |
| 016 | 122023936 | 22.2710575 | 7.9157832 | .002016129 |
| 009 | 122763473 | 22.2934968 | 7.9210994 | .002012072 |
| 004 | 123505992 | 22.3159136 | 7.9264085 | .002008032 |
| 001 | 124251499 | 22.3383079 | 7.9317104 | .002004008 |
| 000 | 125000000 | 22.3606798 | 7.9370053 | .002000000 |
| 001 | 125751501 | 22.3830293 | 7.9422931 | .001996008 |
| 004 | 126506008 | 22.4053565 | 7.9475739 | .001992032 |
| 009 | 127263527 | 22.4276615 | 7.9528477 | .001988072 |
| 016 | 128024064 | 22.4499443 | 7.9581144 | .001984127 |
| 025 | 128787625 | 22.4722051 | 7.9633743 | .001980198 |
| 036 | 129554216 | 22.4944438 | 7.9686271 | .001976285 |
| 049 | 130323843 | 22.5166605 | 7.9738731 | .001972387 |
| 064 | 131096512 | 22.5388553 | 7.9791122 | .001968504 |
| 081 | 131872229 | 22.5610283 | 7.9843444 | .001964637 |
| 100 | 132651000 | 22.5831796 | 7.9895697 | .001960784 |
| 121 | 133432831 | 22.6053091 | 7.9947883 | .001956947 |
| 144 | 134217728 | 22.6274170 | 8.0000000 | .001953125 |
| 169 | 135005697 | 22.6495033 | 8.0052049 | .001949318 |
| 196 | 135796744 | 22.6715681 | 8.0104032 | .001945525 |
| 225 | 136590875 | 22.6936114 | 8.0155946 | .001941748 |
| 256 | 137388096 | 22.7156334 | 8.0207794 | .001937984 |
| 289 | 138188413 | 22.7376340 | 8.0259574 | .001934236 |
| 324 | 138991832 | 22.7596134 | 8.0311287 | .001930502 |
| 361 | 139798359 | 22.7815715 | 8.0362935 | .001926782 |
| 400 | 140608000 | 22.8035085 | 8.0414515 | .001923077 |
| 441 | 141420761 | 22.8254244 | 8.0466030 | .001919386 |
| 484 | 142236648 | 22.8473193 | 8.0517479 | .001915709 |
| 529 | 143055667 | 22.8691933 | 8.0568862 | .001912046 |
| 576 | 143877824 | 22.8910463 | 8.0620180 | .001908397 |
| 625 | 144703125 | 22.9128785 | 8.0671432 | .001904762 |
| 676 | 145531576 | 22.9346899 | 8.0722620 | .001901141 |
| 729 | 146363183 | 22.9564806 | 8.0773743 | .001897533 |
| 784 | 147197952 | 22.9782506 | 8.0824800 | .001893939 |
| 841 | 148035889 | 23.0000000 | 8.0875794 | .001890359 |
| 900 | 148877000 | 23.0217289 | 8.0926723 | .001886792 |
| 961 | 149721291 | 23.0434372 | 8.0977589 | .001883239 |
| 024 | 150568768 | 23.0651252 | 8.1028390 | .001879699 |
| 089 | 151419437 | 23.0867928 | 8.1079128 | .001876173 |
| 156 | 152273304 | 23.1084400 | 8.1129803 | .001872659 |
| 225 | 153130375 | 23.1300670 | 8.1180414 | .001869159 |
| 296 | 153990656 | 23.1516738 | 8.1230962 | .001865672 |
| 369 | 154854153 | 23.1732605 | 8.1281447 | .001862197 |
| 444 | 155720872 | 23.1948270 | 8.1331870 | .001858736 |
| 521 | 156590819 | 23.2163735 | 8.1382230 | .001855288 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS AND RECIPROCALS.

| No. | Square. | Cube. | Square Root. | Cube Root. | Reciprocal. |
|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001551852 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001545629 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001545013 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001541621 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001538235 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001534862 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001531502 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001528154 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001524818 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001521494 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001518182 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001514882 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001511594 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001508318 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001505054 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001501802 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .00179561 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001792332 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001792115 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001789909 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001785714 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001782531 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001779359 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001776199 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001773050 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001769912 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001766784 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001763668 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001760563 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001757469 |
| 572 | 327184 | 187149248 | 23.9165215 | 8.2913444 | .00175386 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .00175183 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .00174882 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .00174588 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .0017421 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .0017391 |
| 578 | 334084 | 193100552 | 24.0000000 | 8.3203353 | .0017361 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .0017331 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | .001730 |
| 581 | 337561 | 196122941 | 24.1039416 | 8.3443410 | .00172 |
| 582 | 338724 | 197137368 | 24.1246762 | 8.3491256 | .00171 |
| 583 | 339889 | 198155287 | 24.1453929 | 8.3539047 | .0017 |
| 584 | 341056 | 199176704 | 24.1660919 | 8.3586784 | .0017 |
| 585 | 342225 | 200201625 | 24.1867732 | 8.3634466 | .0017 |
| 586 | 343396 | 201230056 | 24.2074369 | 8.3682095 | .0017 |
| 587 | 344569 | 202262003 | 24.2280829 | 8.3729668 | .001 |
| 588 | 345744 | 203297472 | 24.2487113 | 8.3777188 | .001 |
| 589 | 346921 | 204336469 | 24.2693222 | 8.3824653 | .001 |
| 590 | 348100 | 205379000 | 24.2899156 | 8.3872065 | .00 |
| 591 | 349281 | 206425071 | 24.3104916 | 8.3919423 | .00 |
| 592 | 350464 | 207474688 | 24.3310501 | 8.3966729 | .0( |
| 593 | 351649 | 208527857 | 24.3515913 | 8.4013981 | .0 |
| 594 | 352836 | 209584584 | 24.3721152 | 8.4061180 | .0 |
| 595 | 354025 | 210644875 | 24.3926218 | 8.4108326 | .( |
| 596 | 355216 | 211708736 | 24.4131112 | 8.4155419 | .( |
| 597 | 356409 | 212776173 | 24.4335834 | 8.4202460 | |
| 598 | 357604 | 213847192 | 24.4540385 | 8.4249448 | |
| 599 | 358801 | 214921799 | 24.4744765 | 8.4296383 | |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS AND RECIPROCALS.

| | Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|---|
| ) | 360000 | 216000000 | 24.4948974 | 8.4343267 | .001666667 |
| L | 361201 | 217081801 | 24.5153013 | 8.4390098 | .001663894 |
| 2 | 362404 | 218167208 | 24.5356883 | 8.4436877 | .001661130 |
| 3 | 363609 | 219256227 | 24.5560583 | 8.4483605 | .001658375 |
| 4 | 364816 | 220348864 | 24.5764115 | 8.4530281 | .001655629 |
| 5 | 366025 | 221445125 | 24.5967478 | 8.4576906 | .001652893 |
| 6 | 367236 | 222545016 | 24.6170673 | 8.4623479 | .001650165 |
| 7 | 368449 | 223648543 | 24.6373700 | 8.4670001 | .001647446 |
| 8 | 369664 | 224755712 | 24.6576560 | 8.4716471 | .001644737 |
| 9 | 370881 | 225866529 | 24.6779254 | 8.4762892 | .001642036 |
| ) | 372100 | 226981000 | 24.6981781 | 8.4809261 | .001639344 |
| L | 373321 | 228099131 | 24.7184142 | 8.4855579 | .001636661 |
| 2 | 374544 | 229220928 | 24.7386338 | 8.4901848 | .001633987 |
| 3 | 375769 | 230346397 | 24.7588368 | 8.4948065 | .001631321 |
| 4 | 376996 | 231475544 | 24.7790234 | 8.4994233 | .001628664 |
| 5 | 378225 | 232608375 | 24.7991935 | 8.5040350 | .001626016 |
| 6 | 379456 | 233744896 | 24.8193473 | 8.5086417 | .001623377 |
| 7 | 380689 | 234885113 | 24.8394847 | 8.5132435 | .001620746 |
| 8 | 381924 | 236029032 | 24.8596058 | 8.5178403 | .001618123 |
| 9 | 383161 | 237176659 | 24.8797106 | 8.5224321 | .001615509 |
| ) | 384400 | 238328000 | 24.8997992 | 8.5270189 | .001612903 |
| L | 385641 | 239483061 | 24.9198716 | 8.5316009 | .001610306 |
| 2 | 386884 | 240641848 | 24.9399278 | 8.5361780 | .001607717 |
| 3 | 388129 | 241804367 | 24.9599679 | 8.5407501 | .001605136 |
| 4 | 389376 | 242970624 | 24.9799920 | 8.5453173 | .001602564 |
| 5 | 390625 | 244140625 | 25.0000000 | 8.5498797 | .001600000 |
| 6 | 391876 | 245314376 | 25.0199920 | 8.5544372 | .001597444 |
| 7 | 393129 | 246491883 | 25.0399681 | 8.5589899 | .001594896 |
| 8 | 394384 | 247673152 | 25.0599282 | 8.5635377 | .001592357 |
| 9 | 395641 | 248858189 | 25.0798724 | 8.5680807 | .001589825 |
| ) | 396900 | 250047000 | 25.0998008 | 8.5726189 | .001587302 |
| L | 398161 | 251239591 | 25.1197134 | 8.5771523 | .001584786 |
| 2 | 399424 | 252435968 | 25.1396102 | 8.5816809 | .001582278 |
| 3 | 400689 | 253636137 | 25.1594913 | 8.5862047 | .001579779 |
| 4 | 401956 | 254840104 | 25.1793566 | 8.5907238 | .001577287 |
| 5 | 403225 | 256047875 | 25.1992063 | 8.5952380 | .001574803 |
| 6 | 404496 | 257259456 | 25.2190404 | 8.5997476 | .001572327 |
| 7 | 405769 | 258474853 | 25.2388589 | 8.6042525 | .001569859 |
| 8 | 407044 | 259694072 | 25.2586619 | 8.6087526 | .001567398 |
| 9 | 408321 | 260917119 | 25.2784493 | 8.6132480 | .001564945 |
| 0 | 409600 | 262144000 | 25.2982213 | 8.6177388 | .001562500 |
| 1 | 410881 | 263374721 | 25.3179778 | 8.6222248 | .001560062 |
| 2 | 412164 | 264609288 | 25.3377189 | 8.6267063 | .001557632 |
| 3 | 413449 | 265847707 | 25.3574447 | 8.6311830 | .001555210 |
| 4 | 414736 | 267089984 | 25.3771551 | 8.6356551 | .001552795 |
| 5 | 416025 | 268336125 | 25.3968502 | 8.6401226 | .001550388 |
| 6 | 417316 | 269586136 | 25.4165301 | 8.6445855 | .001547988 |
| 7 | 418609 | 270840023 | 25.4361947 | 8.6490437 | .001545595 |
| 8 | 419904 | 272097792 | 25.4558441 | 8.6534974 | .001543210 |
| 9 | 421201 | 273359449 | 25.4754784 | 8.6579465 | .001540832 |
| 0 | 422500 | 274625000 | 25.4950976 | 8.6623911 | .001538462 |
| 1 | 423801 | 275894451 | 25.5147016 | 8.6668310 | .001536098 |
| 2 | 425104 | 277167808 | 25.5342907 | 8.6712665 | .001533742 |
| 3 | 426409 | 278445077 | 25.5538647 | 8.6756974 | .001531394 |
| 4 | 427716 | 279726264 | 25.5734237 | 8.6801237 | .001529052 |
| 5 | 429025 | 281011375 | 25.5929678 | 8.6845456 | .001526718 |
| 6 | 430336 | 282300416 | 25.6124969 | 8.6889630 | .001524390 |
| 7 | 431649 | 283593393 | 25.6320112 | 8.6933759 | .001522070 |
| | 432964 | 284890312 | 25.6515107 | 8.6977843 | .001519757 |
| | 434281 | 286191179 | 25.6709953 | 8.7021882 | .001517 |

## SQUARES, CUBES, SQUARE ROOT CUBE ROOTS, AND RECIPROCALS

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. |
|---|---|---|---|---|
| 660 | 435600 | 287496000 | 25.6904652 | 8.7065877 |
| 661 | 436921 | 288804781 | 25.7099203 | 8.7109827 |
| 662 | 438244 | 290117528 | 25.7293607 | 8.7153734 |
| 663 | 439569 | 291434247 | 25.7487864 | 8.7197596 |
| 664 | 440896 | 292754944 | 25.7681975 | 8.7241414 |
| 665 | 442225 | 294079625 | 25.7875939 | 8.7285187 |
| 666 | 443556 | 295408296 | 25.8069758 | 8.7328918 |
| 667 | 444889 | 296740963 | 25.8263431 | 8.7372604 |
| 668 | 446224 | 298077632 | 25.8456960 | 8.7416246 |
| 669 | 447561 | 299418309 | 25.8650343 | 8.7459846 |
| 670 | 448900 | 300763000 | 25.8843582 | 8.7503401 |
| 671 | 450241 | 302111711 | 25.9036677 | 8.7546913 |
| 672 | 451584 | 303464448 | 25.9229628 | 8.7590383 |
| 673 | 452929 | 304821217 | 25.9422435 | 8.7633809 |
| 674 | 454276 | 306182024 | 25.9615100 | 8.7677192 |
| 675 | 455625 | 307546875 | 25.9807621 | 8.7720532 |
| 676 | 456976 | 308915776 | 26.0000000 | 8.7763830 |
| 677 | 458329 | 310288733 | 26.0192237 | 8.7807084 |
| 678 | 459684 | 311665752 | 26.0384331 | 8.7850296 |
| 679 | 461041 | 313046839 | 26.0576284 | 8.7893466 |
| 680 | 462400 | 314432000 | 26.0768096 | 8.7936593 |
| 681 | 463761 | 315821241 | 26.0959767 | 8.7979679 |
| 682 | 465124 | 317214568 | 26.1151297 | 8.8022721 |
| 683 | 466489 | 318611987 | 26.1342687 | 8.8065722 |
| 684 | 467856 | 320013504 | 26.1533937 | 8.8108681 |
| 685 | 469225 | 321419125 | 26.1725047 | 8.8151598 |
| 686 | 470596 | 322828856 | 26.1916017 | 8.8194474 |
| 687 | 471969 | 324242703 | 26.2106848 | 8.8237307 |
| 688 | 473344 | 325660672 | 26.2297541 | 8.8280099 |
| 689 | 474721 | 327082769 | 26.2488095 | 8.8322850 |
| 690 | 476100 | 328509000 | 26.2678511 | 8.8365559 |
| 691 | 477481 | 329939371 | 26.2868789 | 8.8408227 |
| 692 | 478864 | 331373888 | 26.3058929 | 8.8450854 |
| 693 | 480249 | 332812557 | 26.3248932 | 8.8493440 |
| 694 | 481636 | 334255384 | 26.3438797 | 8.8535985 |
| 695 | 483025 | 335702375 | 26.3628527 | 8.8578489 |
| 696 | 484416 | 337153536 | 26.3818119 | 8.8620952 |
| 697 | 485809 | 338608873 | 26.4007576 | 8.8663375 |
| 698 | 487204 | 340068392 | 26.4196896 | 8.8705757 |
| 699 | 488601 | 341532099 | 26.4386081 | 8.8748099 |
| 700 | 490000 | 343000000 | 26.4575131 | 8.8790400 |
| 701 | 491401 | 344472101 | 26.4764046 | 8.8832661 |
| 702 | 492804 | 345948408 | 26.4952826 | 8.8874882 |
| 703 | 494209 | 347428927 | 26.5141472 | 8.8917063 |
| 704 | 495616 | 348913664 | 26.5329983 | 8.8959204 |
| 705 | 497025 | 350402625 | 26.5518361 | 8.9001304 |
| 706 | 498436 | 351895816 | 26.5706605 | 8.9043366 |
| 707 | 499849 | 353393243 | 26.5894716 | 8.9085387 |
| 708 | 501264 | 354894912 | 26.6082694 | 8.9127369 |
| 709 | 502681 | 356400829 | 26.6270539 | 8.9169311 |
| 710 | 504100 | 357911000 | 26.6458252 | 8.9211214 |
| 711 | 505521 | 359425431 | 26.6645833 | 8.9253078 |
| 712 | 506944 | 360944128 | 26.6833281 | 8.9294902 |
| 713 | 508369 | 362467097 | 26.7020598 | 8.9336687 |
| 714 | 509796 | 363994344 | 26.7207784 | 8.9378433 |
| 715 | 511225 | 365525875 | 26.7394839 | 8.9420140 |
| 716 | 512656 | 367061696 | 26.7581763 | 8.9461809 |
| 717 | 514089 | 368601813 | 26.7768557 | 8.9503438 |
| 718 | 515524 | 370146232 | 26.7955220 | 8.9545029 |
| 719 | 516961 | 371694959 | 26.8141754 | 8.9586581 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, AND RECIPROCALS.

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|---|
| 720 | 518400 | 373248000 | 26.8328157 | 8.9628095 | .001388889 |
| 721 | 519841 | 374805361 | 26.8514432 | 8.9669570 | .001386963 |
| 722 | 521284 | 376367048 | 26.8700577 | 8.9711007 | .001385042 |
| 723 | 522729 | 377933067 | 26.8886593 | 8.9752406 | .001383126 |
| 724 | 524176 | 379503424 | 26.9072481 | 8.9793766 | .001381215 |
| 725 | 525625 | 381078125 | 26.9258240 | 8.9835089 | .001379310 |
| 726 | 527076 | 382657176 | 26.9443872 | 8.9876373 | .001377410 |
| 727 | 528529 | 384240583 | 26.9629375 | 8.9917620 | .001375516 |
| 728 | 529984 | 385828352 | 26.9814751 | 8.9958829 | .001373626 |
| 729 | 531441 | 387420489 | 27.0000000 | 9.0000000 | .001371742 |
| 730 | 532900 | 389017000 | 27.0185122 | 9.0041134 | .001369863 |
| 731 | 534361 | 390617891 | 27.0370117 | 9.0082229 | .001367989 |
| 732 | 535824 | 392223168 | 27.0554985 | 9.0123288 | .001366120 |
| 733 | 537289 | 393832837 | 27.0739727 | 9.0164309 | .001364256 |
| 734 | 538756 | 395446904 | 27.0924344 | 9.0205293 | .001362398 |
| 735 | 540225 | 397065375 | 27.1108834 | 9.0246239 | .001360544 |
| 736 | 541696 | 398688256 | 27.1293199 | 9.0287149 | .001358696 |
| 737 | 543169 | 400315553 | 27.1477439 | 9.0328021 | .001356852 |
| 738 | 544644 | 401947272 | 27.1661554 | 9.0368857 | .001355014 |
| 739 | 546121 | 403583419 | 27.1845544 | 9.0409655 | .001353180 |
| 740 | 547600 | 405224000 | 27.2029410 | 9.0450417 | .001351351 |
| 741 | 549081 | 406869021 | 27.2213152 | 9.0491142 | .001349528 |
| 742 | 550564 | 408518488 | 27.2396769 | 9.0531831 | .001347709 |
| 743 | 552049 | 410172407 | 27.2580263 | 9.0572482 | .001345895 |
| 744 | 553536 | 411830784 | 27.2763634 | 9.0613098 | .001344086 |
| 745 | 555025 | 413493625 | 27.2946881 | 9.0653677 | .001342282 |
| 746 | 556516 | 415160936 | 27.3130006 | 9.0694220 | .001340483 |
| 747 | 558009 | 416832723 | 27.3313007 | 9.0734726 | .001338688 |
| 748 | 559504 | 418508992 | 27.3495887 | 9.0775197 | .001336898 |
| 749 | 561001 | 420189749 | 27.3678644 | 9.0815631 | .001335113 |
| 750 | 562500 | 421875000 | 27.3861279 | 9.0856030 | .001333333 |
| 751 | 564001 | 423564751 | 27.4043792 | 9.0896392 | .001331558 |
| 752 | 565504 | 425259008 | 27.4226184 | 9.0936719 | .001329787 |
| 753 | 567009 | 426957777 | 27.4408455 | 9.0977010 | .001328021 |
| 754 | 568516 | 428661064 | 27.4590604 | 9.1017265 | .001326260 |
| 755 | 570025 | 430368875 | 27.4772633 | 9.1057485 | .001324503 |
| 756 | 571536 | 432081216 | 27.4954542 | 9.1097669 | .001322751 |
| 757 | 573049 | 433798093 | 27.5136330 | 9.1137818 | .001321004 |
| 758 | 574564 | 435519512 | 27.5317998 | 9.1177931 | .001319261 |
| 759 | 576081 | 437245479 | 27.5499546 | 9.1218010 | .001317523 |
| 760 | 577600 | 438976000 | 27.5680975 | 9.1258053 | .001315789 |
| 761 | 579121 | 440711081 | 27.5862284 | 9.1298061 | .001314060 |
| 762 | 580644 | 442450728 | 27.6043475 | 9.1338034 | .001312336 |
| 763 | 582169 | 444194947 | 27.6224546 | 9.1377971 | .001310616 |
| 764 | 583696 | 445943744 | 27.6405499 | 9.1417874 | .001308901 |
| 765 | 585225 | 447697125 | 27.6586334 | 9.1457742 | .001307100 |
| 766 | 586756 | 449455096 | 27.6767050 | 9.1497576 | .001305483 |
| 767 | 588289 | 451217663 | 27.6947648 | 9.1537375 | .001303781 |
| 768 | 589824 | 452984832 | 27.7128129 | 9.1577139 | .001302083 |
| 769 | 591361 | 454756609 | 27.7308492 | 9.1616869 | .001300390 |
| 770 | 592900 | 456533000 | 27.7488739 | 9.1656565 | .001298701 |
| 771 | 594441 | 458314011 | 27.7668868 | 9.1696225 | .001297017 |
| 772 | 595984 | 460099648 | 27.7848880 | 9.1735852 | .001295337 |
| 773 | 597529 | 461889917 | 27.8028775 | 9.1775445 | .001293661 |
| 774 | 599076 | 463684824 | 27.8208555 | 9.1815003 | .001291990 |
| 775 | 600625 | 465484375 | 27.8388218 | 9.1854527 | .001290323 |
| 776 | 602176 | 467288576 | 27.8567766 | 9.1894018 | .001288660 |
| 777 | 603729 | 469097433 | 27.8747197 | 9.1933474 | .001287001 |
| 778 | 605284 | 470910952 | 27.8926514 | 9.1972897 | .001285347 |
| 779 | 606841 | 472729139 | 27.9105715 | 9.2012286 | .001283697 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, AND RECIPROCALS.

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals |
|---|---|---|---|---|---|
| 780 | 608400 | 474552000 | 27.9284801 | 9.2051641 | .0012820 |
| 781 | 609961 | 476379541 | 27.9463772 | 9.2090962 | .0012804 |
| 782 | 611524 | 478211768 | 27.9642629 | 9.2130250 | .0012787 |
| 783 | 613089 | 480048687 | 27.9821372 | 9.2169505 | .0012771 |
| 784 | 614656 | 481890304 | 28.0000000 | 9.2208726 | .0012755 |
| 785 | 616225 | 483736625 | 28.0178515 | 9.2247914 | .0012738 |
| 786 | 617796 | 485587656 | 28.0356915 | 9.2287068 | .0012722 |
| 787 | 619369 | 487443403 | 28.0535203 | 9.2326189 | .0012706 |
| 788 | 620944 | 489303872 | 28.0713377 | 9.2365277 | .0012690 |
| 789 | 622521 | 491169069 | 28.0891438 | 9.2404333 | .0012674 |
| 790 | 624100 | 493039000 | 28.1069386 | 9.2443355 | .0012658 |
| 791 | 625681 | 494913671 | 28.1247222 | 9.2482344 | .0012642 |
| 792 | 627264 | 496793088 | 28.1424946 | 9.2521300 | .0012626 |
| 793 | 628849 | 498677257 | 28.1602557 | 9.2560224 | .0012610 |
| 794 | 630436 | 500566184 | 28.1780056 | 9.2599114 | .0012594 |
| 795 | 632025 | 502459875 | 28.1957444 | 9.2637973 | .0012578 |
| 796 | 633616 | 504358336 | 28.2134720 | 9.2676798 | .0012562 |
| 797 | 635209 | 506261573 | 28.2311884 | 9.2715592 | .0012547 |
| 798 | 636804 | 508169592 | 28.2488938 | 9.2754352 | .0012531 |
| 799 | 638401 | 510082399 | 28.2665881 | 9.2793081 | .0012515 |
| 800 | 640000 | 512000000 | 28.2842712 | 9.2831777 | .0012500 |
| 801 | 641601 | 513922401 | 28.3019434 | 9.2870440 | .0012484 |
| 802 | 643204 | 515849608 | 28.3196045 | 9.2909072 | .0012468 |
| 803 | 644809 | 517781627 | 28.3372546 | 9.2947671 | .0012453 |
| 804 | 646416 | 519718464 | 28.3548938 | 9.2986239 | .0012437 |
| 805 | 648025 | 521660125 | 28.3725219 | 9.3024775 | .0012422 |
| 806 | 649636 | 523606616 | 28.3901391 | 9.3063278 | .0012406 |
| 807 | 651249 | 525557943 | 28.4077454 | 9.3101750 | .0012391 |
| 808 | 652864 | 527514112 | 28.4253408 | 9.3140190 | .0012376 |
| 809 | 654481 | 529476129 | 28.4429253 | 9.3178599 | .0012360 |
| 810 | 656100 | 531441000 | 28.4604989 | 9.3216975 | .0012345 |
| 811 | 657721 | 533411731 | 28.4780617 | 9.3255320 | .0012330 |
| 812 | 659344 | 535387328 | 28.4956137 | 9.3293634 | .0012315 |
| 813 | 660969 | 537367797 | 28.5131549 | 9.3331916 | .0012300 |
| 814 | 662596 | 539353144 | 28.5306852 | 9.3370167 | .0012285 |
| 815 | 664225 | 541343375 | 28.5482048 | 9.3408386 | .0012269 |
| 816 | 665856 | 543338496 | 28.5657137 | 9.3446575 | .0012254 |
| 817 | 667489 | 545338513 | 28.5832119 | 9.3484731 | .0012239 |
| 818 | 669124 | 547343432 | 28.6006993 | 9.3522857 | .0012224 |
| 819 | 670761 | 549353259 | 28.6181760 | 9.3560952 | .0012210 |
| 820 | 672400 | 551368000 | 28.6356421 | 9.3599016 | .0012195 |
| 821 | 674041 | 553387661 | 28.6530976 | 9.3637049 | .0012180 |
| 822 | 675684 | 555412248 | 28.6705424 | 9.3675051 | .0012165 |
| 823 | 677329 | 557441767 | 28.6879766 | 9.3713022 | .0012150 |
| 824 | 678976 | 559476224 | 28.7054002 | 9.3750963 | .0012135 |
| 825 | 680625 | 561515625 | 28.7228132 | 9.3788873 | .0012121 |
| 826 | 682276 | 563559976 | 28.7402157 | 9.3826752 | .0012106 |
| 827 | 683929 | 565609283 | 28.7576077 | 9.3864600 | .0012091 |
| 828 | 685584 | 567663552 | 28.7749891 | 9.3902419 | .0012077 |
| 829 | 687241 | 569722789 | 28.7923601 | 9.3940206 | .0012062 |
| 830 | 688900 | 571787000 | 28.8097206 | 9.3977964 | .0012048 |
| 831 | 690561 | 573856191 | 28.8270706 | 9.4015691 | .0012033 |
| 832 | 692224 | 575930368 | 28.8444102 | 9.4053387 | .0012019 |
| 833 | 693889 | 578009537 | 28.8617394 | 9.4091054 | .0012004 |
| 834 | 695556 | 580093704 | 28.8790582 | 9.4128690 | .0011990 |
| 835 | 697225 | 582182875 | 28.8963666 | 9.4166297 | .0011976 |
| 836 | 698896 | 584277056 | 28.9136646 | 9.4203873 | .0011961 |
| 837 | 700569 | 586376253 | 28.9309523 | 9.4241420 | .0011947 |
| 838 | 702244 | 588480472 | 28.9482297 | 9.4278936 | .0011933 |
| 839 | 703921 | 590589719 | 28.9654967 | 9.4316422 | .0011919 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, AND RECIPROCALS.

| Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|
| 705600 | 592704000 | 28.9827535 | 9.4353880 | .001190476 |
| 707281 | 594823321 | 29.0000000 | 9.4391307 | .001189061 |
| 708964 | 596947688 | 29.0172363 | 9.4428704 | .001187648 |
| 710649 | 599077107 | 29.0344623 | 9.4466072 | .001186240 |
| 712336 | 601211584 | 29.0516781 | 9.4503410 | .001184834 |
| 714025 | 603351125 | 29.0688837 | 9.4540719 | .001183432 |
| 715716 | 605495736 | 29.0860791 | 9.4577999 | .001182033 |
| 717409 | 607645423 | 29.1032644 | 9.4615249 | .001180638 |
| 719104 | 609800192 | 29.1204396 | 9.4652470 | .001179245 |
| 720801 | 611960049 | 29.1376046 | 9.4689661 | .001177856 |
| 722500 | 614125000 | 29.1547595 | 9.4726824 | .001176471 |
| 724201 | 616295051 | 29.1719043 | 9.4763957 | .001175088 |
| 725904 | 618470208 | 29.1890390 | 9.4801061 | .001173709 |
| 727609 | 620650477 | 29.2061637 | 9.4838136 | .001172333 |
| 729316 | 622835864 | 29.2232784 | 9.4875182 | .001170960 |
| 731025 | 625026375 | 29.2403830 | 9.4912200 | .001169591 |
| 732736 | 627222016 | 29.2574777 | 9.4949188 | .001168224 |
| 734449 | 629422793 | 29.2745623 | 9.4986147 | .001166861 |
| 736164 | 631628712 | 29.2916370 | 9.5023078 | .001165501 |
| 737881 | 633839779 | 29.3087018 | 9.5059980 | .001164144 |
| 739600 | 636056000 | 29.3257566 | 9.5096854 | .001162791 |
| 741321 | 638277381 | 29.3428015 | 9.5133699 | .001161440 |
| 743044 | 640503928 | 29.3598365 | 9.5170515 | .001160093 |
| 744769 | 642735647 | 29.3768616 | 9.5207303 | .001158749 |
| 746496 | 644972544 | 29.3938769 | 9.5244063 | .001157407 |
| 748225 | 647214625 | 29.4108823 | 9.5280794 | .001156069 |
| 749956 | 649461896 | 29.4278779 | 9.5317497 | .001154734 |
| 751689 | 651714363 | 29.4448637 | 9.5354172 | .001153403 |
| 753424 | 653972032 | 29.4618397 | 9.5390818 | .001152074 |
| 755161 | 656234909 | 29.4788059 | 9.5427437 | .001150748 |
| 756900 | 658503000 | 29.4957624 | 9.5464027 | .001149425 |
| 758641 | 660776311 | 29.5127091 | 9.5500589 | .001148106 |
| 760384 | 663054848 | 29.5296461 | 9.5537123 | .001146789 |
| 762129 | 665338617 | 29.5465734 | 9.5573630 | .001145475 |
| 763876 | 667627624 | 29.5634910 | 9.5610108 | .001144165 |
| 765625 | 669921875 | 29.5803989 | 9.5646559 | .001142857 |
| 767376 | 672221376 | 29.5972972 | 9.5682982 | .001141553 |
| 769129 | 674526133 | 29.6141858 | 9.5719377 | .001140251 |
| 770884 | 676836152 | 29.6310648 | 9.5755745 | .001138952 |
| 772641 | 679151439 | 29.6479342 | 9.5792085 | .001137656 |
| 774400 | 681472000 | 29.6647939 | 9.5828397 | .001136364 |
| 776161 | 683797841 | 29.6816442 | 9.5864682 | .001135074 |
| 777924 | 686128968 | 29.6984848 | 9.5900939 | .001133787 |
| 779689 | 688465387 | 29.7153159 | 9.5937169 | .001132503 |
| 781456 | 690807104 | 29.7321375 | 9.5973373 | .001131222 |
| 783225 | 693154125 | 29.7489496 | 9.6009548 | .001129944 |
| 784996 | 695506456 | 29.7657521 | 9.6045696 | .001128668 |
| 786769 | 697864103 | 29.7825452 | 9.6081817 | .001127396 |
| 788544 | 700227072 | 29.7993289 | 9.6117911 | .001126126 |
| 790321 | 702595369 | 29.8161030 | 9.6153977 | .001124859 |
| 792100 | 704969000 | 29.8328678 | 9.6190017 | .001123596 |
| 793881 | 707347971 | 29.8496231 | 9.6226030 | .001122334 |
| 795664 | 709732288 | 29.8663690 | 9.6262016 | .001121076 |
| 797449 | 712121957 | 29.8831056 | 9.6297975 | .001119821 |
| 799236 | 714516984 | 29.8998328 | 9.6333907 | .001118568 |
| 801025 | 716917375 | 29.9165506 | 9.6369812 | .001117318 |
| 802816 | 719323136 | 29.9332591 | 9.6405690 | .001116071 |
| *804609* | *721734273* | 29.9499683 | 9.6441542 | .001114827 |
| *806404* | *724150792* | 29.9666481 | 9.6477367 | .001113586 |
| *808201* | *726572699* | 29.9833287 | 9.6513166 | .001112347 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, AND RECIPROCALS.

| No. | Squares. | Cubes. | Square Roots. | Cube Roots. | Recipr |
|---|---|---|---|---|---|
| 900 | 810000 | 729000000 | 30.0000000 | 9.6548938 | .00111 |
| 901 | 811801 | 731432701 | 30.0166620 | 9.6584684 | .00110 |
| 902 | 813604 | 733870808 | 30.0333148 | 9.6620403 | .00110 |
| 903 | 815409 | 736314327 | 30.0499584 | 9.6656096 | .00110 |
| 904 | 817216 | 738763264 | 30.0665928 | 9.6691762 | .00110 |
| 905 | 819025 | 741217625 | 30.0832179 | 9.6727403 | .00110 |
| 906 | 820836 | 743677416 | 30.0998339 | 9.6763017 | .00110 |
| 907 | 822649 | 746142643 | 30.1164407 | 9.6798604 | .00110 |
| 908 | 824464 | 748613312 | 30.1330383 | 9.6834166 | .00110 |
| 909 | 826281 | 751089429 | 30.1496269 | 9.6869701 | .00110 |
| 910 | 828100 | 753571000 | 30.1662063 | 9.6905211 | .00109 |
| 911 | 829921 | 756058031 | 30.1827765 | 9.6940694 | .00109 |
| 912 | 831744 | 758550528 | 30.1993377 | 9.6976151 | .00109 |
| 913 | 833569 | 761048497 | 30.2158899 | 9.7011583 | .00109 |
| 914 | 835396 | 763551944 | 30.2324329 | 9.7046989 | .00109 |
| 915 | 837225 | 766060875 | 30.2489669 | 9.7082369 | .00109 |
| 916 | 839056 | 768575296 | 30.2654919 | 9.7117723 | .00109 |
| 917 | 840889 | 771095213 | 30.2820079 | 9.7153051 | .00109 |
| 918 | 842724 | 773620632 | 30.2985148 | 9.7188354 | .00108 |
| 919 | 844561 | 776151559 | 30.3150128 | 9.7223631 | .00108 |
| 920 | 846400 | 778688000 | 30.3315018 | 9.7258883 | .00108 |
| 921 | 848241 | 781229961 | 30.3479818 | 9.7294109 | .00108 |
| 922 | 850084 | 783777448 | 30.3644529 | 9.7329309 | .00108 |
| 923 | 851929 | 786330467 | 30.3809151 | 9.7364484 | .00108 |
| 924 | 853776 | 788889024 | 30.3973683 | 9.7399634 | .00108 |
| 925 | 855625 | 791453125 | 30.4138127 | 9.7434758 | .00108 |
| 926 | 857476 | 794022776 | 30.4302481 | 9.7469857 | .00107 |
| 927 | 859329 | 796597983 | 30.4466747 | 9.7504930 | .00107 |
| 928 | 861184 | 799178752 | 30.4630924 | 9.7539979 | .00107 |
| 929 | 863041 | 801765089 | 30.4795013 | 9.7575002 | .00107 |
| 930 | 864900 | 804357000 | 30.4959014 | 9.7610001 | .00107 |
| 931 | 866761 | 806954491 | 30.5122926 | 9.7644974 | .00107 |
| 932 | 868624 | 809557568 | 30.5286750 | 9.7679922 | .00107 |
| 933 | 870489 | 812166237 | 30.5450487 | 9.7714845 | .00107 |
| 934 | 872356 | 814780504 | 30.5614136 | 9.7749743 | .00107 |
| 935 | 874225 | 817400375 | 30.5777697 | 9.7784616 | .00106 |
| 936 | 876096 | 820025856 | 30.5941171 | 9.7819466 | .00106 |
| 937 | 877969 | 822656953 | 30.6104557 | 9.7854288 | .00106 |
| 938 | 879844 | 825293672 | 30.6267857 | 9.7889087 | .00106 |
| 939 | 881721 | 827936019 | 30.6431069 | 9.7923861 | .00106 |
| 940 | 883600 | 830584000 | 30.6594194 | 9.7958611 | .00106 |
| 941 | 885481 | 833237621 | 30.6757233 | 9.7993336 | .00106 |
| 942 | 887364 | 835896888 | 30.6920185 | 9.8028036 | .00106 |
| 943 | 889249 | 838561807 | 30.7083051 | 9.8062711 | .00106 |
| 944 | 891136 | 841232384 | 30.7245830 | 9.8097362 | .00106 |
| 945 | 893025 | 843908625 | 30.7408523 | 9.8131989 | .00105 |
| 946 | 894916 | 846590536 | 30.7571130 | 9.8166591 | .00105 |
| 947 | 896809 | 849278133 | 30.7733651 | 9.8201169 | .00105 |
| 948 | 898704 | 851971392 | 30.7896086 | 9.8235723 | .00105 |
| 949 | 900601 | 854670349 | 30.8058436 | 9.8270252 | .00105 |
| 950 | 902500 | 857375000 | 30.8220700 | 9.8304757 | .00105 |
| 951 | 904401 | 860085351 | 30.8382879 | 9.8339238 | .00105 |
| 952 | 906304 | 862801408 | 30.8544972 | 9.8373695 | .00105 |
| 953 | 908209 | 865523177 | 30.8706981 | 9.8408127 | .00104 |
| 954 | 910116 | 868250664 | 30.8868904 | 9.8442536 | .00104 |
| 955 | 912025 | 870988875 | 30.9030743 | 9.8476920 | .00104 |
| 956 | 913936 | 873722816 | 30.9192497 | 9.8511280 | .00104 |
| 957 | 915849 | 876467493 | 30.9354166 | 9.8545617 | .00104 |
| 958 | 917764 | 879217912 | 30.9515751 | 9.8579929 | .00104 |
| | 919681 | 881974079 | 30.9677251 | 9.8614218 | .00104 |

# SQUARES, CUBES, SQUARE ROOTS, CUBE ROOTS, AND RECIPROCALS.

| Squares. | Cubes. | Square Roots. | Cube Roots. | Reciprocals. |
|---|---|---|---|---|
| 921600 | 884736000 | 30.9838668 | 9.8648483 | .001041667 |
| 923521 | 887503681 | 31.0000000 | 9.8682724 | .001040583 |
| 925444 | 890277128 | 31.0161248 | 9.8716941 | .001039501 |
| 927369 | 893056347 | 31.0322413 | 9.8751135 | .001038422 |
| 929296 | 895841344 | 31.0483494 | 9.8785305 | .001037344 |
| 931225 | 898632125 | 31.0644491 | 9.8819451 | .001036269 |
| 933156 | 901428696 | 31.0805405 | 9.8853574 | .001035197 |
| 935089 | 904231063 | 31.0966236 | 9.8887673 | .001034126 |
| 937024 | 907039232 | 31.1126984 | 9.8921749 | .001033058 |
| 938961 | 909853209 | 31.1287648 | 9.8955801 | .001031992 |
| 940900 | 912673000 | 31.1448230 | 9.8989830 | .001030928 |
| 942841 | 915498611 | 31.1608729 | 9.9023835 | .001029866 |
| 944784 | 918330048 | 31.1769145 | 9.9057817 | .001028807 |
| 946729 | 921167317 | 31.1929479 | 9.9091776 | .001027749 |
| 948676 | 924010424 | 31.2089731 | 9.9125712 | .001026694 |
| 950625 | 926859375 | 31.2249900 | 9.9159624 | .001025641 |
| 952576 | 929714176 | 31.2409987 | 9.9193513 | .001024590 |
| 954529 | 932574833 | 31.2569992 | 9.9227379 | .001023541 |
| 956484 | 935441352 | 31.2729915 | 9.9261222 | .001022495 |
| 958441 | 938313739 | 31.2889757 | 9.9295042 | .001021450 |
| 960400 | 941192000 | 31.3049517 | 9.9328839 | .001020408 |
| 962361 | 944076141 | 31.3209195 | 9.9362613 | .001019368 |
| 964324 | 946966168 | 31.3368792 | 9.9396363 | .001018330 |
| 966289 | 949862087 | 31.3528308 | 9.9430092 | .001017294 |
| 968256 | 952763904 | 31.3687743 | 9.9463797 | .001016260 |
| 970225 | 955671625 | 31.3847097 | 9.9497479 | .001015228 |
| 972196 | 958585256 | 31.4006369 | 9.9531138 | .001014199 |
| 974169 | 961504803 | 31.4165561 | 9.9564775 | .001013171 |
| 976144 | 964430272 | 31.4324673 | 9.9598389 | .001012146 |
| 978121 | 967361669 | 31.4483704 | 9.9631981 | .001011122 |
| 980100 | 970299000 | 31.4642654 | 9.9665549 | .001010101 |
| 982081 | 973242271 | 31.4801525 | 9.9699095 | .001009082 |
| 984064 | 976191488 | 31.4960315 | 9.9732619 | .001008065 |
| 986049 | 979146657 | 31.5119025 | 9.9766120 | .001007049 |
| 988036 | 982107784 | 31.5277655 | 9.9799599 | .001006036 |
| 990025 | 985074875 | 31.5436206 | 9.9833055 | .001005025 |
| 992016 | 988047936 | 31.5594677 | 9.9866488 | .001004016 |
| 994009 | 991026973 | 31.5753068 | 9.9899900 | .001003009 |
| 996004 | 994011992 | 31.5911380 | 9.9933289 | .001002004 |
| 998001 | 997002999 | 31.6069613 | 9.9966656 | .001001001 |
| 1000000 | 1000000000 | 31.6227766 | 10.0000000 | .001000000 |
| 1002001 | 1003003001 | 31.6385840 | 10.0033322 | .0009990010 |
| 1004004 | 1006012008 | 31.6543836 | 10.0066622 | .0009980040 |
| 1006009 | 1009027027 | 31.6701752 | 10.0099899 | .0009970090 |
| 1008016 | 1012048064 | 31.6859590 | 10.0133155 | .0009960159 |
| 1010025 | 1015075125 | 31.7017349 | 10.0166389 | .0009950249 |
| 1012036 | 1018108216 | 31.7175030 | 10.0199601 | .0009940358 |
| 1014049 | 1021147343 | 31.7332633 | 10.0232791 | .0009930487 |
| 1016064 | 1024192512 | 31.7490157 | 10.0265958 | .0009920635 |
| 1018081 | 1027243729 | 31.7647603 | 10.0299104 | .0009910803 |
| 1020100 | 1030301000 | 31.7804972 | 10.0332228 | .0009900990 |
| 1022121 | 1033364331 | 31.7962262 | 10.0365330 | .0009891197 |
| 1024144 | 1036433728 | 31.8119474 | 10.0398410 | .0009881423 |
| 1026169 | 1039509197 | 31.8276609 | 10.0431469 | .0009871668 |
| 1028196 | 1042590744 | 31.8433666 | 10.0464506 | .0009861933 |
| 1030225 | 1045678375 | 31.8590646 | 10.0497521 | .0009852217 |
| 1032256 | 1048772096 | 31.8747549 | 10.0530514 | .0009842520 |
| 1034289 | 1051871913 | 31.8904374 | 10.0563485 | .0009832842 |
| 1036324 | 1054977832 | 31.9061123 | 10.0596435 | .0009823183 |
| 1038361 | 1058089859 | 31.9217794 | 10.0629364 | .0009813543 |

# WEIGHTS AND MEASURES.

## AVOIRDUPOIS WEIGHT.

### UNITED STATES AND BRITISH.

| Grains. | Drams. | Ounces. | Pounds. | Hundred-weight. |
|---|---|---|---|---|
| 1. | .03657 | .002286 | .000143 | .0000012 |
| 27.34375 | 1. | .0625 | .003906 | .0000348 |
| 437.5 | 16. | 1. | .0625 | .0005580 |
| 7000. | 256. | 16. | 1. | .0089286 |
| 784000. | 28672. | 1792. | 112. | 1. |
| 5680000. | 573440. | 35840. | 2240. | 20. |

1 pound avoirdupois = 1.215278 pounds troy.
1 net ton = 2000 pounds = .892857 gross tons.

## TROY WEIGHT.

### UNITED STATES AND BRITISH.

| Grains. | Pennyweight. | Ounces. | |
|---|---|---|---|
| 1 | .041667 | .0020833 | |
| 24 | 1. | .05 | |
| 480 | 20. | 1. | |
| 5760 | 240. | 12. | |

1 pound troy = .822857 pounds avoirdupois.
175 ounces troy = 192 ounces avoirdupois.

## APOTHECARIES' WEIGHT.

### UNITED STATES AND BRITISH.

| Grains. | Scruples. | Drams. | Ounces. | |
|---|---|---|---|---|
| 1 | .05 | .016667 | .0020833 | |
| 20 | 1. | .333333 | .0416667 | |
| 60 | 3. | 1. | .125 | |
| 480 | 24. | 8. | 1. | |
| 5760 | 288. | 96. | 12. | |

The pound, ounce and grain are the same as in troy we
The avoirdupois grain = troy grain = apothecaries' g

# WEIGHTS AND MEASURES—Continued.

## LINEAR MEASURE.

### UNITED STATES AND BRITISH.

| Inches. | Feet. | Yards. | Rods. | Furlong. | Miles. |
|---|---|---|---|---|---|
| 1 | .08333 | .02778 | .0050505 | .00012626 | .00001578 |
| 12 | 1. | .33333 | .0606061 | .00151515 | .00018939 |
| 36 | 3. | 1. | .1818182 | .00454545 | .00056818 |
| 198 | 16.5 | 5.5 | 1. | .025 | .003125 |
| 7920 | 660. | 220. | 40. | 1. | .125 |
| 63360 | 5280. | 1760. | 320. | 8. | 1. |

## ROPE AND CABLE MEASURE.

1 inch = .111111 spans = .013889 fathoms = .0001157 cable's length.
1 span = 9 inches = .125 fathoms = .00104167 cable's length.
1 fathom = 6 feet = 8 spans = 72 inches = .008333 cable's length.
1 cable's length = 120 fathoms = 720 feet = 960 spans = 8640 inches.

## NAUTICAL MEASURE.

1 nautical mile, as adopted by the United States Coast and Geodetic Survey, equals the length of one minute of arc of a great circle of a sphere whose surface equals that of the earth = 6080.204 feet = 1.1516 statute miles.
1 league = 3 nautical miles = 18240.613 feet.

## GUNTER'S CHAIN.

1 link = 7.92 inches = .01 chain = .000125 miles.
1 chain = 100 links = 66 feet = 4 rods = .0125 miles.
1 mile = 80 chains = 8000 links.

## SQUARE OR LAND MEASURE.

### UNITED STATES AND BRITISH.

| Square Inches. | Square Feet. | Square Yards. | Square Rods. | Acres. | Square Miles. |
|---|---|---|---|---|---|
| 1 | .006944 | .0007716 | . . . . . | . . . . . | . . . . . |
| 144 | 1. | .111111 | . . . . . | . . . . . | . . . . . |
| 1296 | 9.0 | 1. | .03306 | .0002066 | . . . . . |
| 39204 | 272.25 | 30.25 | 1. | .00625 | .00000977 |
| 6272640 | 43560. | 4840. | 160. | 1. | .0015625 |
| | 27878400. | 3097600. | 102400. | 640. | 1. |

1 square rood = 40 square rods.
1 acre = 4 square roods.
1 square acre = 208.71 feet square.

# WEIGHTS AND MEASURES—Continued.

## CUBIC OR SOLID MEASURE.

### UNITED STATES OR BRITISH.

1 cubic inch = .0005787 cubic feet = .000021433 cubic yards.

1 cubic foot = 1728 cubic inches = .037037 cubic yards.

1 cubic yard = 27 cubic feet = 46656 cubic inches.

1 cord of wood = 128 cubic feet = 4 feet by 4 feet by 8 feet.

1 perch of masonry = 24.75 cubic feet = 16.5 feet by 1.5 feet by 1 foot. usually taken as 25 cubic feet.

## DRY MEASURE.

### UNITED STATES ONLY.

| Pints. | Quarts. | Gallons. | Pecks. | Bushels. | Cubic In |
|---|---|---|---|---|---|
| 1 | .50 | .125 | .0625 | .015625 | 33.60 |
| 2 | 1. | .25 | .125 | .03125 | 67.20 |
| 8 | 4. | 1. | .05 | .125 | 268.80 |
| 16 | 8. | 2. | 1. | .25 | 537.60 |
| 64 | 32. | 8. | 4. | 1. | 2150.42 |

1 heaped bushel = 1.25 struck bushel, and the cone must be not le 6 inches high.

## LIQUID MEASURE.

### UNITED STATES ONLY.

| Gills. | Pints. | Quarts. | Gallons. | Barrels. | Cubic In |
|---|---|---|---|---|---|
| 1 | .25 | .125 | .03125 | .000498 | 7.2 |
| 4 | 1. | .5 | .125 | .003968 | 28.8 |
| 8 | 2. | 1. | .25 | .007937 | 57.7 |
| 32 | 8. | 4. | 1. | .031746 | 231. |
| 2008 | 252. | 126. | 31.5 | 1. | 7276.5 |

The British imperial gallon = 277.274 cubic inches or 10 pounds avoi of pure water at 62° F. and barometer at 30 inches.

The British imperial gallon = 1.20032 United States gallon.

*1 fluid* drachm = 60 minims = .125 fluid ounces = .0078125 pints.

*1 fluid* ounce = 480 minims = 8 drachms = .0625 pints.

# WEIGHTS AND MEASURES—Continued.

## METRIC SYSTEM.

### MEASURES OF LENGTH, CAPACITY AND WEIGHT.

| LENGTH. | Kilometre. | Hecto-metre. | Decametre. | Metre. | Decimetre. | Centimetre. | Millimetre. |
|---|---|---|---|---|---|---|---|
| CAPACITY. | Kilolitre or Stere. | Hectolitre or Decistere. | Decalitre or Centistere. | Litre or Millistere. | Decilitre. | Centilitre. | Millilitre. |
| WEIGHT. | Kilo-gramme. | Hecto-gramme. | Deca-gramme. | Gramme. | Decigramme. | Centi-gramme. | Milli-gramme. |
| | 1 | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| | | 1 | 10 | 100 | 1000 | 10000 | 100000 |
| | | | 1 | 10 | 100 | 1000 | 10000 |
| | | | | 1 | 10 | 100 | 1000 |
| | | | | .1 | 1 | 10 | 100 |
| | | | | .01 | .1 | 1 | 10 |
| | | | | .001 | .01 | .1 | 1 |

1 myriametre = 10 kilometres = 10000 metres.
1 tonne = 1000 kilogrammes = 100 quintals = 10 myriagrammes.
1 gramme = 1 cubic centimetre of distilled water at its maximum density at sea level in latitude of Paris and barometer at 760 millimetres.
1 litre = 1 cubic decimeter.

## METRIC SYSTEM.

### SQUARE OR SURFACE MEASURE.

| Square Kilometre. | Square Hectometre or Hectare. | Square Decametre or Are. | Square Metre or Centiare. | Square Decimetre. | Square Centimetre. | Square Millimetre. |
|---|---|---|---|---|---|---|
| 1 | 100 | 10000 | 1000000 | | | |
| | 1 | 100 | 10000 | 1000000 | | |
| | .01 | 1 | 100 | 10000 | 1000000 | |
| | .0001 | .01 | 1 | 100 | 10000 | 1000000 |
| | .000001 | .0001 | .01 | 1 | 100 | 10000 |
| | | .000001 | .0001 | .01 | 1 | 100 |
| | | | .000001 | .0001 | .01 | 1 |

1 square myriametre = 100 square kilometres = 100 000 000 square metres.

## METRIC SYSTEM.

### CUBIC MEASURE.

| Cubic Decametre. | Cubic Metre. | Cubic Decimetre. | Cubic Centimetre. | Cubic Millimetre. |
|---|---|---|---|---|
| 1 | 1000 | 1000000 | 1000000000 | |
| .001 | 1 | 1000 | 1000000 | 1000000000 |
| .000001 | .001 | 1 | 1000 | 1000000 |
| .000000001 | .000001 | .001 | 1 | 1000 |
| | .000000001 | .000001 | .001 | 1 |

1 cubic metre = 1 kilolitre = 1 stere.

# TABLES FOR CONVERTING UNITED STATES WEIGHTS AND MEASURES.

## CUSTOMARY TO METRIC.

### Weights.

| No. | Grains to Milligrammes. | Troy Ounces to Grammes. | Avoirdupois Ounces to Grammes. | Avoirdupois Pounds to Kilogrammes. | Net Tons of 2000 Pounds to Tonnes. | Gross Tons of 2240 Pounds to Tonnes. |
|---|---|---|---|---|---|---|
| 1 | 64.79892 | 31.10348 | 28.34953 | .45359 | .90718 | 1.01605 |
| 2 | 129.59784 | 62.20696 | 56.69905 | .90718 | 1.81437 | 2.03209 |
| 3 | 194.39675 | 93.31044 | 85.04858 | 1.36078 | 2.75155 | 3.04814 |
| 4 | 259.19567 | 124.41392 | 113.39811 | 1.81437 | 3.62874 | 4.06419 |
| 5 | 323.99459 | 155.51740 | 141.74763 | 2.26796 | 4.53592 | 5.08024 |
| 6 | 388.79351 | 186.62088 | 170.09716 | 2.72155 | 5.44311 | 6.09628 |
| 7 | 453.59243 | 217.72437 | 198.44669 | 3.17515 | 6.35029 | 7.11233 |
| 8 | 518.39135 | 248.82785 | 226.79621 | 3.62874 | 7.25748 | 8.12838 |
| 9 | 583.19026 | 279.93133 | 255.14574 | 4.08233 | 8.16466 | 9.14442 |

1 Avoirdupois Pound = 453.5924277 Grammes.

### Linear Measure.

| No. | 64ths of an Inch to Millimetres. | Inches to Centimetres. | Feet to Metres. | Yards to Metres. | Statute Miles to Kilometres. | Nautical Miles to Kilometres. |
|---|---|---|---|---|---|---|
| 1 | .39688 | 2.54001 | .304801 | .914402 | 1.60935 | 1.85325 |
| 2 | .79375 | 5.08001 | .609601 | 1.828804 | 3.21869 | 3.70650 |
| 3 | 1.19063 | 7.62002 | .914402 | 2.743205 | 4.82804 | 5.55975 |
| 4 | 1.58750 | 10.16002 | 1.219202 | 3.657607 | 6.43739 | 7.41300 |
| 5 | 1.98438 | 12.70003 | 1.524003 | 4.572009 | 8.04674 | 9.26625 |
| 6 | 2.38125 | 15.24003 | 1.828804 | 5.486411 | 9.65608 | 11.11950 |
| 7 | 2.77813 | 17.78004 | 2.133604 | 6.400813 | 11.26543 | 12.97275 |
| 8 | 3.17501 | 20.32004 | 2.438405 | 7.315215 | 12.87478 | 14.82600 |
| 9 | 3.57188 | 22.86005 | 2.743205 | 8.229616 | 14.48412 | 16.67925 |

1 Nautical Mile = 1853.25 Metres.
1 Gunter's Chain = 20.1168 Metres.
1 Fathom = 1.829 Metres.

# TABLES FOR CONVERTING UNITED STATES WEIGHTS AND MEASURES.

## METRIC TO CUSTOMARY.

### Weights.

| No. | Milligrammes to Grains. | Grammes to Troy Ounces. | Grammes to Avoirdupois Ounces. | Kilogrammes to Avoirdupois Pounds. | Tonnes to Net Tons of 2000 Pounds. | Tonnes to Gross Tons of 2240 Pounds. |
|---|---|---|---|---|---|---|
| 1 | .01543 | .03215 | .03527 | 2.20462 | 1.10231 | .98421 |
| 2 | .03086 | .06430 | .07055 | 4.40924 | 2.20462 | 1.96841 |
| 3 | .04630 | .09645 | .10582 | 6.61387 | 3.30693 | 2.95262 |
| 4 | .06173 | .12860 | .14110 | 8.81849 | 4.40924 | 3.93682 |
| 5 | .07716 | .16075 | .17637 | 11.02311 | 5.51156 | 4.92103 |
| 6 | .09259 | .19290 | .21164 | 13.22773 | 6.61387 | 5.90524 |
| 7 | .10803 | .22506 | .24692 | 15.43236 | 7.71618 | 6.88944 |
| 8 | .12346 | .25721 | .28219 | 17.63698 | 8.81849 | 7.87365 |
| 9 | .13889 | .28936 | .31747 | 19.84160 | 9.92080 | 8.85785 |

1 Kilogramme = 15432.35639 Grains.

### Linear Measure.

| No. | Millimetres to 64ths of an Inch. | Centimetres to Inches. | Metres to Feet. | Metres to Yards. | Kilometres to Statute Miles. | Kilometres to Nautical Miles. |
|---|---|---|---|---|---|---|
| 1 | 2.51968 | .39370 | 3.280833 | 1.093611 | .62137 | .53959 |
| 2 | 5.03936 | .78740 | 6.561667 | 2.187222 | 1.24274 | 1.07919 |
| 3 | 7.55904 | 1.18110 | 9.842500 | 3.280833 | 1.86411 | 1.61878 |
| 4 | 10.07872 | 1.57480 | 13.123333 | 4.374444 | 2.48548 | 2.15837 |
| 5 | 12.59840 | 1.96850 | 16.404167 | 5.468056 | 3.10685 | 2.69796 |
| 6 | 15.11808 | 2.36220 | 19.685000 | 6.561667 | 3.72822 | 3.23756 |
| 7 | 17.63776 | 2.75590 | 22.965833 | 7.655278 | 4.34959 | 3.77715 |
| 8 | 20.15744 | 3.14960 | 26.246667 | 8.748889 | 4.97096 | 4.31674 |
| 9 | 22.67712 | 3.54330 | 29.527500 | 9.842500 | 5.59233 | 4.85633 |

# TABLES FOR CONVERTING UNITED S
# WEIGHTS AND MEASURES.

## CUSTOMARY TO METRIC.

### Square Measure.

| No. | Square Inches to Square Centimetres. | Square Feet to Square Metres. | Square Yards to Square Metres. | Acres to Hectares. |
|---|---|---|---|---|
| 1 | 6.45163 | .09290 | .83613 | .40470 |
| 2 | 12.90325 | .18581 | 1.67226 | .80939 |
| 3 | 19.35488 | .27871 | 2.50839 | 1.21409 |
| 4 | 25.80650 | .37161 | 3.34452 | 1.61879 |
| 5 | 32.25813 | .46452 | 4.18065 | 2.02349 |
| 6 | 38.70975 | .55742 | 5.01679 | 2.42818 |
| 7 | 45.16138 | .65032 | 5.85292 | 2.83288 |
| 8 | 51.61300 | .74323 | 6.68905 | 3.23758 |
| 9 | 58.06463 | .83613 | 7.52518 | 3.64228 |

1 Square Statute Mile = 259.00 Hectares.

### Cubic Measure.

| No. | Cubic Inches to Cubic Centimetres. | Cubic Inches to Cubic Decimetres. | Cubic Feet to Cubic Metres. | Cubic Yards to Cubic Metres. |
|---|---|---|---|---|
| 1 | 16.38716 | .01639 | .02832 | .76456 |
| 2 | 32.77432 | .03277 | .05663 | 1.52912 |
| 3 | 49.16148 | .04916 | .08495 | 2.29368 |
| 4 | 65.54864 | .06555 | .11327 | 3.05824 |
| 5 | 81.93580 | .08194 | .14159 | 3.82280 |
| 6 | 98.32296 | .09832 | .16990 | 4.58736 |
| 7 | 114.71013 | .11471 | .19822 | 5.35192 |
| 8 | 131.09729 | .13110 | .22654 | 6.11648 |
| 9 | 147.48445 | .14748 | .25485 | 6.88104 |

# TABLES FOR CONVERTING UNITED STATES WEIGHTS AND MEASURES.

## METRIC TO CUSTOMARY.

### Square Measure.

| o. | Square Centimetres to Square Inches. | Square Metres to Square Feet. | Square Metres to Square Yards. | Hectares to Acres. | Square Kilometres to Square Miles. |
|---|---|---|---|---|---|
| 1 | .15500 | 10.76387 | 1.19599 | 2.47104 | .38610 |
| 2 | .31000 | 21.52773 | 2.39197 | 4.94209 | .77220 |
| 3 | .46500 | 32.29160 | 3.58796 | 7.41313 | 1.15830 |
| 4 | .62000 | 43.05547 | 4.78394 | 9.88418 | 1.54440 |
| 5 | .77500 | 53.81934 | 5.97993 | 12.35522 | 1.93050 |
| 6 | .93000 | 64.58320 | 7.17591 | 14.82626 | 2.31660 |
| 7 | 1.08500 | 75.34707 | 8.37190 | 17.29731 | 2.70270 |
| 8 | 1.24000 | 86.11094 | 9.56788 | 19.76835 | 3.08880 |
| 9 | 1.39500 | 96.87481 | 10.76387 | 22.23940 | 3.47490 |

1 Hectare = .003861 Square Statute Miles.

### Cubic Measure.

| o. | Cubic Centimetres to Cubic Inches. | Cubic Decimetres to Cubic Inches. | Cubic Metres to Cubic Feet. | Cubic Metres to Cubic Yards. | |
|---|---|---|---|---|---|
| 1 | .06102 | 61.02338 | 35.31445 | 1.30794 | |
| 2 | .12205 | 122.04676 | 70.62891 | 2.61589 | |
| 3 | .18307 | 183.07013 | 105.94336 | 3.92383 | |
| 4 | .24409 | 244.09351 | 141.25782 | 5.23177 | |
| 5 | .30512 | 305.11689 | 176.57227 | 6.53971 | |
| 6 | .36614 | 366.14027 | 211.88673 | 7.84766 | |
| 7 | .42716 | 427.16365 | 247.20118 | 9.15560 | |
| 8 | .48819 | 488.18702 | 282.51564 | 10.46354 | |
| 9 | .54921 | 549.21040 | 317.83009 | 11.77149 | |

# TABLES FOR CONVERTING UNITED STA WEIGHTS AND MEASURES.

## CUSTOMARY TO METRIC.

### Capacity Measures.

| No. | Liquid Quarts to Litres. | Gallons to Litres. | Gallons to Cubic Metres. | Bushels to Hectolitres. | Fluid Drachms to Millilitres or Cubic Centimetres. | F t C |
|---|---|---|---|---|---|---|
| 1 | .94636 | 3.78543 | .00379 | .35239 | 3.69671 | |
| 2 | 1.89272 | 7.57087 | .00757 | .70479 | 7.39343 | |
| 3 | 2.83908 | 11.35630 | .01136 | 1.05718 | 11.09014 | |
| 4 | 3.78543 | 15.14174 | .01514 | 1.40957 | 14.78685 | 1 |
| 5 | 4.73179 | 18.92717 | .01893 | 1.76196 | 18.48357 | 1 |
| 6 | 5.67815 | 22.71260 | .02271 | 2.11436 | 22.18028 | 1 |
| 7 | 6.62451 | 26.49804 | .02650 | 2.46675 | 25.87699 | 2 |
| 8 | 7.57087 | 30.28347 | .03028 | 2.81914 | 29.57370 | 2 |
| 9 | 8.51723 | 34.06891 | .03407 | 3.17154 | 33.27042 | 2 |

### Miscellaneous.

| No. | Pounds per Lineal Foot to Kilogrammes per Lineal Metre. | Pounds per Square Inch to Kilogrammes per Square Centimetre. | Pounds per Square Foot to Kilogrammes per Square Metre. | Pounds per Cubic Foot to Kilogrammes per Cubic Metre. | Foot-Pounds to Kilogramme-Metres. | U I H |
|---|---|---|---|---|---|---|
| 1 | 1.48816 | .07031 | 4.88241 | 16.01837 | .13826 | |
| 2 | 2.97632 | .14061 | 9.76482 | 32.03674 | .27651 | |
| 3 | 4.46448 | .21092 | 14.64723 | 48.05510 | .41477 | |
| 4 | 5.95264 | .28123 | 19.52963 | 64.07348 | .55302 | |
| 5 | 7.44081 | .35153 | 24.41204 | 80.09185 | .69128 | |
| 6 | 8.92897 | .42184 | 29.29445 | 96.11021 | .82953 | |
| 7 | 10.41713 | .49215 | 34.17686 | 112.12858 | .96779 | |
| 8 | 11.90529 | .56245 | 39.05927 | 128.14695 | 1.10604 | |
| 9 | 13.39345 | .63276 | 43.94168 | 144.16532 | 1.24430 | |

# TABLES FOR CONVERTING UNITED STATES WEIGHTS AND MEASURES.

## METRIC TO CUSTOMARY.

### Capacity Measures.

| No. | Litres to Fluid Quarts. | Litres to Gallons. | Cubic Metres to Gallons. | Hectolitres to Bushels | Millilitres or Cubic Centimetres to Fluid Drachms. | Millilitres Cubic Cen metres t Fluid Oun |
|---|---|---|---|---|---|---|
| 1 | 1.05668 | .26417 | 264.17047 | 2.83774 | .27051 | .0338 |
| 2 | 2.11336 | .52834 | 528.34093 | 5.67548 | .54102 | .0676 |
| 3 | 3.17005 | .79251 | 792.51140 | 8.51323 | .81153 | .1014 |
| 4 | 4.22673 | 1.05668 | 1056.68187 | 11.35097 | 1.08204 | .1352 |
| 5 | 5.28341 | 1.32085 | 1320.85234 | 14.18871 | 1.35255 | .1690 |
| 6 | 6.34009 | 1.58502 | 1585.02280 | 17.02645 | 1.62306 | .2028 |
| 7 | 7.39677 | 1.84919 | 1849.19327 | 19.86420 | 1.89357 | .2367 |
| 8 | 8.45345 | 2.11336 | 2113.36374 | 22.70194 | 2.16408 | .2705 |
| 9 | 9.51014 | 2.37753 | 2377.53420 | 25.53968 | 2.43460 | .3043 |

### Miscellaneous.

| No. | Kilogrammes per Lineal Metre to Pounds per Lineal Foot. | Kilogrammes per Square Centimetre to Pounds per Square Inch. | Kilogrammes per Square Metre to Pounds per Square Foot. | Kilogrammes per Cubic Metre to Pounds per Cubic Foot. | Kilogramme-Metres to Foot-Pounds. | Metric Horsepowe United St Horsepow |
|---|---|---|---|---|---|---|
| 1 | .67197 | 14.22340 | .20482 | .06243 | 7.23300 | .986 |
| 2 | 1.34393 | 28.44680 | .40963 | .12486 | 14.46600 | 1.972 |
| 3 | 2.01590 | 42.67020 | .61445 | .18728 | 21.69899 | 2.958 |
| 4 | 2.68787 | 56.89359 | .81927 | .24971 | 28.93199 | 3.945 |
| 5 | 3.35984 | 71.11699 | 1.02408 | .31214 | 36.16499 | 4.931 |
| 6 | 4.03180 | 85.34039 | 1.22890 | .37457 | 43.39799 | 5.917 |
| 7 | 4.70377 | 99.56379 | 1.43372 | .43700 | 50.63098 | 6.904 |
| 8 | *5.37574* | *113.78719* | 1.63854 | .49943 | 57.86398 | 7.89 |
| 9 | *6.04770* | *128.01059* | 1.84335 | .56185 | 65.09698 | 8.8 |

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